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Notes on the blackening of Baptisia tinctoria

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Any one who is accustomed to the aspect of our dry open fields or sandy hills in the summer can not have failed to notice the Wild Indigo (Yellow Indigo Broom, *Baptisia tinctoria* (L.) R. Br.). The bright yellow flowers and small three-parted leaves make a very conspicuous plant. In early July, on Cape Cod, before the flowers are open the plants are green, but a few weeks later a black twig or branch will be noticed, and by August often whole plants will be black, even the flowers. If a green leaf is pinched or injured so that the epidermis is broken, there will presently be a black spot at the injury, and it is generally the branches which have been stepped on or have suffered from an insect burrowing into the stem near the ground, which are the first to show this very characteristic blackening. It is not always due to an injury; an apparently healthy plant will be so black that one can easily believe that a good substitute for indigo could be found in it, and indeed during the Civil War this was tried; while in drying it is well known how dark a specimen it makes.

The following facts were noted at the Marine Biological Laboratory at Woods Hole, Massachusetts, during some studies made at Dr. True's suggestion and with his kind assistance, upon the cause of the blackening of the leaves of *Baptisia tinctoria*. It was thought probably to be due to an oxidizing enzyme, and various experiments were tried to prove whether or not this was the case.

It may be well to say a word about the enzymes. Effront *

* Effront, J. Les enzymes et leurs applications, 63, 64. 1899.

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has classified them into three large groups according to the effects which they produce:

A. Soluble hydrating ferments or enzymes.

B. Soluble oxidizing enzymes.

C. Enzymes causing molecular decomposition.

It is with the middle group that this paper is concerned. The oxidizing enzymes are found in both animals and plants, are widely distributed in all the parts of plants and in every kind of plant from bacteria to the phanerogams. Laccase, the first of the oxidases to be discovered (in 1883 by Yoshida, a Japanese chemist), makes lacquer; malase acts on fruits and causes apples and pears to turn brown when exposed to air; and others are connected with the ripening of olives or are found in wine. Without giving them actual names, like the foregoing, there are two kinds of oxidases generally recognized by the differences of their reactions, one "oxidase," which oxidizes guaiaconic acid (the characteristic reactive in the guaiac resin) to guaiac blue without the aid of peroxide of hydrogen, and the other "peroxidase," which oxidizes it only when this substance is present.*

There is a third, catalase, which according to Loew † is of general occurrence in the vegetable kingdom.

In this paper only very general experiments are described, but the methods of preparation of the material and ways of applying the tests are the ones usually adopted for this kind of work.

Preparation of material. — Fresh stems were gathered and the leaves stripped off; flowers also were used when present, but not the pod or thicker stems, as these could not easily be sufficiently broken up. The leaves were ground up in a mortar with quite fine sand, which had been previously treated with dilute hydrochloric acid and washed until no acid reaction could be detected with litmus paper, then dried in the sun. When ground, the leaves were covered with distilled water and left to macerate for a period of a half to one hour; the extract was next filtered, the leaves being squeezed in a cloth as dry as possible and thrown away. The filtrate was treated with three times its bulk of strong

* Loew, O. Curing and fermentation of cigar leaf tobacco, 27. (U. S. Dept. Agriculture Rep. No. 59.) 1899.

† Loew, O. Catalase, 30. (U. S. Dept. Agriculture Rep. No. 68.) 1901.

alcohol and left for an hour or two, to precipitate chlorophyl, proteins and other matters; this precipitate, dissolved in distilled water, was filtered again, and this solution used for the experiments.

Kinds of extracts made. — It was found that as soon as the pounded leaves were exposed to the air they turned from green to black in less than half an hour, whereas those not so much exposed kept green. So two kinds of extracts were made, one in which the pounded leaves were at once covered with water, when only those near the top became black, another in which the pounded leaves were left for twenty-four hours to get as black as possible in the air, and then extracted as usual. The first method gave a dark brown solution which kept growing darker so that it was difficult to see the color-reactions; the second gave a clear amber-colored extract, free from the products of oxidation, easily showing the slightest reaction to color tests, but otherwise acting like the first. In order to get purer enzyme solutions, a portion of the original solution was treated with three times its bulk of alcohol and filtered, dissolving the precipitate in water, and this process was repeated, thus securing second and third extractions much lighter and clearer and rather more sensitive than the first.

In general 95 per cent. alcohol was used for the first treatment, and 80 per cent. for the second and third. Although some absolute alcohol was also used for the first extraction and gave much heavier precipitates, it was too expensive to use in the necessary quantities. There was little difference in the amount of precipitate between 95 per cent. and 80 per cent. alcohol.

Tests for enzymes. — When the extracts were ready they were tested by taking about ten cubic centimeters in a tube and adding a few drops of solution of gum guaiac (2 grams of guaiac in 100 cubic centimeters of absolute alcohol); then the solution turned an opalescent blue, becoming slightly darker when shaken, and a clear blue on adding 95 per cent. alcohol, which dissolves the excess of guaiac. This showed that an oxidase was undoubtedly present. Upon the addition of one drop of hydrogen peroxide, the solution turned a very deep blue, and this color would last several hours without fading. This second reaction suggested the presence of a peroxidase. These two tests were used in all the

experiments, the colors given above being considered the normal reaction and any variations, as the rapidity in the change, or shades of blue, were taken to mark disturbance in the action of the enzyme. It was found that the guaiac solution did not keep its power more than three or four days. The best reactions were produced the day it was made up. Green * considers that it is not safe to rely upon the guaiac test as a method of recognition for an oxidase, as several ordinary chemical and mineral compounds also yield a blue color with it, and says the surer way is to isolate the enzyme and prove its presence by its action. On the other hand Loew † considers that "such objections are groundless when fresh organized tissues are under investigation. Other oxidizing influences are easily recognized by control tests, which the careful worker will not omit to make. . . . Such blue reactions are not restricted to certain limits of temperature as the reactions of oxidizing enzymes are."

Temperature experiments. — These were made by putting five or ten cubic centimeters of the enzyme solution into tubes and exposing them for five, ten, fifteen and thirty minutes as nearly as possible to the same temperature, by means of water baths. Exposures begun at 55° C. and up to 75° C. showed no difference from the normal. At 75° C. for shorter exposures the guaiac or oxidase reaction was slower in appearing and not such a good blue, and the hydrogen peroxide or peroxidase coloring became greener and clear, instead of deep blue. For longer exposures the reactions were still slower.

At 79° C. to 81° C. for thirty minutes the guaiac reaction was very slight; the peroxide light blue, and the color faded.

At 85° C. for five or ten minutes there was almost no reaction to gum guaiac, and the peroxide reaction was green and clear and slow; while at 86° to 87° C. for twenty and thirty minutes there was no reaction to either. Therefore the thermal destruction point is 86° C. for long exposures and 87° C. for shorter times, that of the oxidase being probably a few degrees lower than that for the peroxidase; the third extractions were a trifle more sensitive than the original one.

* Green, J. R. The soluble ferments and fermentation. 1899.

† Loew, O. Physiological studies of Connecticut leaf tobacco, 31. (U. S. Dept. Agriculture Rep. No. 65.) 1900.

These conclusions are drawn from over fifty experiments made under the same conditions with the various solutions, each solution being tried at least twice, generally more often, at each degree of temperature between the extremes indicated.

A little different temperature test was made by holding branches with the leaves on in water at 70°, 80°, 90° and 100° C. for five, ten and fifteen minutes, then mashing the leaves and precipitating with alcohol and testing as usual. In this way the enzyme was not destroyed until the branch had been at 90° C. for fifteen minutes, and even then there was a little reaction with hydrogen peroxide. At the boiling point of water the oxidase was destroyed by a five-minute exposure, the peroxidase by a ten-minute exposure. Even this high temperature for less than five minutes does not quite destroy the enzyme, and this fact was noticed with a solution which gave reactions when brought once to the boiling point, and ceased only when boiled several minutes. The leaves on the branches when exposed to the lower degrees for short periods turned dark or black on drying, while the boiled ones remained green.

These temperature results correspond fairly well with those given for the maple leaf by Woods.* He found that in the plant tissues both the oxidase and the peroxidase will stand somewhat higher temperature than in aqueous or alcoholic solutions. The oxidase of a hard maple leaf is usually destroyed by heating five minutes at 70° C. in an aqueous solution; the peroxidase requires five minutes at 80° C. In the leaf, however, it took fifteen minutes at 85° C. to destroy them, while both were destroyed in a 50 per cent. alcoholic solution in three minutes at 70°–72° C. The enzymes of other leaves behaved in a similar manner. The tobacco oxidase is destroyed between 65° and 66° C. and the peroxidase between 87° and 88° C. On this subject Loew† says: "The temperatures thus far observed which render enzymes inactive are not constant under all conditions; the acidity of the plant juice, the degree of dilution, the duration of the heating, and the presence of certain salts have a modifying influence on the height of

* Woods, A. F. The destruction of chlorophyll by oxidizing enzymes. Centralbl. Bakteriol. Parasit. Abt. 2. **5**: 745–754. 1899.

† Loew, O. Physiological studies of Connecticut leaf tobacco, **21**. 1900.

the temperature at which the change to the inactive modification takes place." He then gives destruction temperatures for several oxidases in various plants, which vary from 60° to 95° C.

Citric acid tests.— Ten cubic centimeters of the enzyme solution were put in tubes, then by means of a burette 1 cc., .5 cc., and .2 cc. of citric acid of different strengths were added, the tubes set aside for an hour and then tested with the solution of gum guaiac and hydrogen peroxide. Citric acid (normal) was used to begin with, then one fourth normal, one eighth normal and one sixteenth normal, each one tried in three tubes with the three different amounts of acid. The normal solution gave no result at all, except a heavy brown precipitate.

The quarter normal, when only two tenths cubic centimeters were added, gave a weak guaiac reaction and a gray-blue peroxide coloration.

With one half a cubic centimeter of the one eighth normal solution there was a fair reaction with both, but not normal in color, the good colors being reached only with .2 cc. of the one sixteenth normal solution. In all but the last there was a precipitate; in the stronger solutions this was brown, in the weaker blue, and in most the color faded. No definite conclusions could be drawn from these results.

Sodium hydroxide tests. — These were made in the same way as those with citric acid: a one quarter normal solution was the strongest used (ten grams in one litre of water), the weaker ones being one quarter, one eight and one sixteenth of that. Results follow:

One quarter normal — no reaction with either guaiac or hydrogen peroxide, a clear yellow liquid.

$\frac{1}{12}$ normal. (10 cc. $\frac{1}{4}$ normal and 30 cc. H_2O.)	$\frac{1}{32}$ normal. (5 cc. $\frac{1}{4}$ normal and 35 cc. H_2O.)	$\frac{1}{64}$ normal. ($2\frac{1}{2}$ cc. $\frac{1}{4}$ normal and $37\frac{1}{2}$ cc. H_2O.)
.5 cc. in a few cases gave a slight reaction to guaiac, none to H_2O_2. .2 cc. and less gave generally a guaiac reaction, occasionally one with H_2O_2.	Most of these experiments gave a guaiac reaction, but none with H_2O_2 until only .2 cc. was used.	All gave guaiac reaction, though greenish instead of blue, and with .5 and .2 cc. there was a reaction to H_2O_2, though green instead of blue.

The sodium hydroxide solution gave a yellow color to the

enzyme solutions which was noticeable even in the weaker ones, making the color reactions greenish instead of blue. There was no precipitate in any and the color faded in most of them. In these results it is seen that it is the oxidase which is more resistant, while in the thermal tests it was the peroxidase. Loew * states that in the majority of cases the oxidase will prove the more energetic of the two but it succumbs much more quickly to noxious influences, as alcohol or heat.

A few experiments were tried with both citric acid and sodium hydroxide, using for each .5 cc. of $\frac{1}{8}$ normal solution (where a slight though decided reaction to both guaiac and hydrogen peroxide was observed), and then heating the tubes. It was found that the thermal destruction point was thus reduced from 86° to 79° C.

MISCELLANEOUS EXPERIMENTS

1. The experiments given above seemed to prove that there were two oxidases and it was thought probable that catalase was also present, but although two attempts were made to prove this neither was successful. Hydrogen peroxide was poured on freshly chopped leaves and though bubbles came off, when collected they proved to be only air, not oxygen. However, when hydrogen peroxide was dropped on freshly made hand-sections of the stem many air-bubbles came off, especially from the wood and xylem, which action may have been due in part to catalase, as this property of developing oxygen by decomposition of hydrogen peroxide is one which Loew † proved to belong to catalase.

2. Tubes with enzyme solution were exposed to sunlight and strong light for several hours, together with controls wrapped in black paper, so that all were at the same temperature, but all gave perfectly normal reactions.

3. A solution of hydroquinone was made up (one gram in 100 cubic centimeters of distilled water), and equal amounts of this and the enzyme solutions, and one tube of distilled water and hydroquinone were put aside in the dark, for twenty four hours. As no result was apparent for this period they were left for a

* Loew, O. Curing and fermentation of cigar leaf tobacco, 30. 1899.

† Loew, O. Physiological studies of Connecticut leaf tobacco, 23. 1900 — Loew, O. Catalase. 1901.

week; then the solutions had all become a rich, red, clear sherry color, that with distilled water also having a reddish tinge.

4. One drop of twenty per cent. ferric chloride turned a solution of freshly chopped leaves in water a deep black, showing the presence of tannin, but none could be detected in the alcoholic extracts.

5. The various extracts seemed to be quite neutral, that is, they produced no change in either blue or pink litmus paper, even when kept some days so that there was a decided musty or cider smell. A few drops of chloroform do not affect the action of the enzymes and keep the solutions from growing musty.

In the field those branches which had turned black were in general injured in some way, by being stepped on, blown over or sometimes some insect eggs were found in the hollow stems of older branches. These are some suggestions as to the possible cause for the starting of the action of the enzymes.

In the plants which are described in Woods' interesting paper he enzymes show much greater activity in or near the cells which are injured in a leaf than in the normal green cells. He suggests that the insects which cause punctures may "inject substances possibly related to saliva into the wounds which they produce, and it may be the irration caused by these substances which is responsible for the increase of oxidase and peroxidase." He also states that these enzymes rapidly destroy chlorophyl and that "under certain conditions not yet well understood" they "either become active or else are produced in abnormally large quantities, causing variegations and various diseases." *

"The oxidizing enzymes are evidently contained in the plasmatic living part of the cell, and not in the cell sap which fills the vacuoles. On the other hand, the matters easily oxidized by them and representing products of metabolism or by-products of certain synthetical operations are mostly contained in the cell sap. These matters, often of a chromogenic character, are, of course, produced in the plasmatic parts, but secreted rapidly into the cell sap. When the cells die the soluble substances locally separated in the cytoplasm and the cell sap intimately mix, since the coagulating protoplasm, becoming easily permeable, can no

* Woods, *l. c.* 754.

longer retain any soluble matters—as, for example, oxidase. Thus after death the direct action of the oxidase on the oxidizable matter of the cell sap sets in with a production of colored bodies, as is the case in the tobacco leaves. This action can also be noticed very well in the juice pressed out from the fresh leaves, since this juice, containing cell sap as well as soluble matters previously contained in the protoplasm, turns brown rapidly on coming into contact with air. The darkening of the juices of potatoes, beets, and other plants depends upon the same principle." *

It might be concluded from these two extracts that though present in the whole plant of *Baptisia tinctoria*, the enzymes have become particularly active in the blackened parts, and that these black parts have become susceptible to the enzyme from having lost their vitality from some cause. The black leaves do not seem dead, and always contain plenty of chlorophyl. Of course the blackness is the product of oxidation, but my observations would suggest a possibility that there is a pigment as well, which gives the extreme dark color, so much darker than the same product in potatoes and beets and tobacco, and so different from the white and green of variegated leaves.

SUMMARY

The blackening of the leaves of *Baptisia tinctoria* is due to oxidizing enzymes.

There are at least two enzymes, an oxidase which gives an opalescent blue with gum guaiac solution and is destroyed by heat at about 83°–84° C., and a peroxidase which gives a deep blue with hydrogen peroxide and which has a thermal destruction point of 86°–87° C.

Both enzymes can be destroyed with dilute solutions of citric acid and sodium hydroxide.

I wish to express my gratitude to Dr. D. T. MacDougal and Dr. W. J. Gies of the New York Botanical Garden, for their kind assistance and advice in revising this paper.

* Loew, O. Physiological studies of Connecticut leaf tobacco, 40, 41. 1900.

Studies on the Rocky Mountain flora — XIII

PER AXEL RYDBERG

Dodecatheon multiflorum sp. nov.

Plant glabrous, perennial with a very short caudex and cluster of fibrous roots; leaves about 2 dm. long, sinuate-denticulate, obtusish, narrowly oblanceolate, tapering below into a short petiole; scape stout 3–4 dm. high; bracts linear-lanceolate, 1–2 cm. long; flowers 10–20; the longer pedicels often over 1 dm. long; calyx-tube 5–6 mm. long, more or less turbinate at the base; lobes lanceolate, about 5 mm. long; corolla bluish violet, paler in the throat but without any markings; lobes oblong, obtuse; filament-tube obsolete; anthers narrowly linear-lanceolate, acute, 7–8 mm. long; connective narrow, lance-subulate, with a longitudinal groove, but not rugose; capsule about 12 mm. long, cylindric-ovoid, septicidal.

In habit this species resembles *D. radicatum* and *D. pauciflorum*, but differs in the stamens, which are almost without a filament-tube. In river valleys at an altitude of 2400–2700 m.

COLORADO: Sangre de Cristo Creek, 1900, *Rydberg & Vreeland 5781*.

WYOMING: Elk Mountains, 1899, *Little & Stanton*.

Dodecatheon radicatum sinuatum var. nov.

Leaves more elongated than in the type, oblong, rarely elliptic, sinuate, thin.

COLORADO: Foothills, Larimer County, 1890, *Crandall* (type); Buena Vista, 1892, *C. S. Sheldon*; Fort Collins, 1896, *Baker*.

Gentianella Clementis sp. nov.

Annual, usually more or less branched, 2–4 dm. high; stem sharply angled; internodes usually longer than the leaves; these 3–6 cm. long, the basal ones spatulate, the cauline ones lanceolate, acuminate, truncate or even subcordate at the base, sessile; peduncles 1–4 from the axils of the leaves, more or less elongated 1–6 cm. long; sepals linear, acute, usually very unequal in length, the longer often ⅔ as long as the blue or greenish-yellow corolla; corolla 15–18 mm. long; lobes ovate-lanceolate, acute.

This belongs to the *Amarella* group of *Gentiana* and is perhaps most nearly related to *G. plebeja*, which, however, has shorter ovate or ovate-lanceolate, acute or obtuse stem-leaves, lower stem and shorter and more nearly equal calyx-lobes. *G. Clementis* grows in the mountains from South Dakota and Montana to Colorado and Arizona. As the type I regard the following:

COLORADO: Minnehaha, 1901, *Clements 253*.

Frasera speciosa stenosepala var. nov.

Usually with very numerous flowers; sepals narrowly linear, some of them usually equaling or exceeding the petals; petals large, about 15 mm. long or more; floral leaves very long and narrow.

In the mountains and foothills of Colorado and Wyoming. As the type may be regarded:

COLORADO: Foothills, Larimer County, 1895, *Cowen*.

Frasera speciosa angustifolia var. nov.

Low, 3–4 dm. high; basal leaves very short; stem-leaves narrowly linear-lanceolate; floral leaves, except the lower, shorter than the branches of the inflorescence; petals rather small, about 12 mm. long.

On dry hillsides from Montana to Colorado. As the type may be regarded:

MONTANA: Lima, 1895, *Shear 3369*.

Gilia scariosa sp. nov.

Perennial with a tap-root; stems one to several, simple, strict, 3–6 dm. high, glandular-puberulent throughout; leaves numerous, alternate, pinnatifid with linear-filiform spinulose-tipped divisions, more or less white-villous when young, glandular-puberulent; inflorescence a narrow, strict, interrupted thyrsus; branches very short, few-flowered; calyx-tube about 6 mm. long, puberulent, scarious except the green angles; teeth short, broadly rounded-ovate, abruptly contracted into a subulate acumination; corolla pink, 3–4 cm. long; tube narrow, very gradually broadening upwards; lobes ovate-lanceolate, acute, about 8 mm. long; stamens very unequally inserted; capsule obovoid, about 1 cm. long.

This is closely related to *G. aggregata*, but differs in the scarious calyx with short, abruptly cuspidate-acuminate lobes. The lobes of the corolla are also acute rather than acuminate. The

species is common in Colorado, in open valleys. It was first collected by James in Long's expedition; but James' specimen in the Torrey herbarium is a mere scrap. I have therefore selected as the type a better specimen, viz.:

COLORADO: Veta Pass, 1896, *C. L. Shear 3590.*

Gilia spergulifolia sp. nov.

Gilia congesta crebrifolia Wats, King's Exp. **5**: 268, in part. 1871. Not *G. crebrifolia* Nutt.

Low perennial, more or less woody at the base, more or less cespitose; flowering branches 5–10 cm. high, more or less pubescent with white, crisp hairs or puberulent; leaves linear-filiform, entire or the upper rarely with 1–2 similar lobes, tipped with a pungent point; flowers in capitate clusters, which are usually on naked peduncles; bracts similar to the leaves but smaller; calyx villous with short subulate pungent teeth; corolla 4–5 mm. long, white; lobes oblong, obtuse, a little over 1 mm. long.

This has been mistaken for *G. crebrifolia* Nutt., but that species has much shorter fleshy leaves and very short copiously leafy flowering stems. It is nearer related to *G. iberidifolia*, from which it differs in the entire leaves and solitary heads ending the branches.

WYOMING: Headwaters of Tongue River, 1898, *Tweedy 576* (type).

COLORADO: Arboles, 1899, *Baker 534.*

UTAH: Bear River Valley, 1869, *Watson 917.*

Gilia roseata sp. nov.

Perennial with a woody base, cespitose; flowering branches about 1 dm. high, purple-tinged, more or less villous or crisp-hairy; leaves pinnatifid with linear-filiform pungent-pointed lobes, about 2 cm. long; flowers capitate at the ends of the leafy branches; bracts similar, shorter, rose-tinged and more villous; calyx also very pubescent and rose-tinged; lobes subulate and spinulose-pointed; corolla about 8 mm. long; its lobes 4–5 mm. long, elliptic, obtuse.

This species is nearly related to *G. iberidifolia*, but differs in the larger flowers (in *G. iberidifolia* the corolla-lobes are rarely over 2 mm. long), the rose-colored bracts, purplish stem and more solitary heads.

COLORADO: Grand Junction, 1892, *Alice Eastwood.*

Gilia polyantha sp. nov.

Perennial with a short woody base; stems several, 3–4 dm. high, striate and simple up to the inflorescence, glandular-puberulent; leaves 3–4 cm. long, pinnatifid, glabrous or with a few white hairs; lobes linear-filiform, pungent-pointed; flowers numerous in a narrow thyrsus; calyx campanulate, about 5 mm. long, more or less scarious at the sinuses; lobes broadly ovate-triangular, abrubtly cuspidate-pungent; corolla white, about 1 cm. long, funnelform-salvershaped; lobes about 5 mm. long, lance-oblong, obtusish; filaments about equaling the corolla-lobes, somewhat incurved.

This has been mistaken for *G. multiflora* Nutt., but is more closely related to *G. Macombii* Torr., differing mainly in the shorter corolla and shorter pubescence.

COLORADO: Pagosa Springs, 1899, *Baker 538*.

Gilia Tweedyi sp. nov.

Annual, branched, 2–4 dm. high; stem and branches glandular-puberulent, especially the upper part; leaves 2–3 cm. long, pinnatifid, with lanceolate cuspidate lobes; flowers paniculate; pedicels 1–8 mm. long; calyx about 3 mm. long, scarious between the green ribs; lobes lanceolate; corolla funnelform, about 4 mm. long, bluish; capsule ovoid, about 4 mm. long.

This species is related to *G. inconspicua* and *G. minutiflora*. From the former it differs in the smaller corolla, of which not only the corolla-tube but also the throat is included in the calyx; from the latter it differs in the pinnatifid leaves. *G. Tweedyi* grows in river bottoms and on sandy soil, at an altitude of 1000–2200 m.

WYOMING: Encampment, Carbon County, 1901, *Tweedy 4422* (type); between Sheridan and Buffalo, 1900, *Tweedy 3481*; Fort Steele, 1901, *Tweedy 4421*; also, 1898, *Aven Nelson 4802*.

Gilia Crandallii sp. nov.

Perennial with a woody tap-root; stem 3–5 dm. high, sparingly puberulent, glandular above, rather stout, much branched; basal leaves 3–10 cm. long, spatulate or oblanceolate, serrate or pinnately lobed, with lanceolate teeth or lobes; lower stem-leaves often similar; the upper narrower and usually entire; calyx glandular, about 5 mm. long; teeth lanceolate, scarious-margined; corolla salvershaped, about 15 mm. long, rose color; tube about 1 mm.

wide below, about 2 mm. at the throat; lobes oblong-spatulate, acutish; capsule about 5 mm. long, acute.

This has been mistaken for *G. Haydeni*, but that species is a much more slender plant with shorter calyx, scarcely scarious-margined lobes, minute subulate stem-leaves and shorter (3.5 mm. long) obtuse capsule. It is more closely related to *G. subnuda*, but differs in the branched stems and the finer and sparser pubescence. It grows in dry soil, especially on "sage-plains," at an altitude of 1900–2100 m.

COLORADO: Durango, 1898, *Crandall 2053* (type) and *2040*; also 1896, *Tweedy 448*; Mancos, 1898, *Baker, Earle & Tracy 404*; also 1901, *Vreeland 885*.

Polemonium robustum sp. nov.

Perennial with a woody caudex; stem 4–10 dm. high, more or less short-villous and above glandular; leaves 6–10 cm. long, glandular-pubescent; leaflets 11–17, lanceolate or lance-oblong, acute, 1.5–2.5 cm. long; the upper confluent and decurrent on the rachis; inflorescence much branched and corymbiform, but the main axis usually overtopping the branches; calyx glandular-villous, 7–8 mm. long; lobes lanceolate; corolla rose or purplish, 12–15 mm. high; lobes rounded and obtuse.

This species is a close relative to *P. foliosissimum*, but differs in the large flowers and the more conical or obovoid inflorescence. It grows in the mountains of Colorado, especially along streams, at an altitude of 2400–3000 m.

COLORADO: Bob Creek, La Plata Mountains, 1898, *Baker, Earle & Tracy 274* (type); Keblar Pass, 1901, *Baker 796*; Clear Creek Cañon, 1885, *Patterson 104*; Sangre de Cristo Creek, 1900, *Rydberg & Vreeland 5718*; Veta Pass, 1900, *Rydberg & Vreeland 5717*.

Polemonium Grayanum sp. nov.

Perennial with a cespitose rootstock; stems about 1 dm. high, glandular-villous; leaves 3–5 cm. long, glandular-villous; leaflets at least of the basal leaves more or less verticillate, obovate or spatulate, 2–6 mm. long, obtuse; calyx about 18 mm. long, villous with white hairs; lobes linear-lanceolate; corolla about 2 cm. long, campanulate-funnelform with a wide tube; lobes rounded.

This species is nearest related to *P. viscosum* Nutt., but is characterized by the long white hairs on the calyx. It grows on the

higher peaks of Colorado among rocks, at an altitude of 2700–4000 m.

COLORADO: Gray's Peak, 1895, *Rydberg* (type); also 1886, *Letterman 323*; Graymount, *Letterman 322*; Central City, 1869, *Leville*.

Phacelia sericea ciliosa var. nov.

Usually taller than the typical *P. sericea*, often 5 dm. high, not silvery, green; pubescence very sparse and short, except some long silky hairs on the pedicels and lower portion of the stem.

This variety has been mistaken for *P. Lyallii* and *P. idahoensis*. It has been confused with the first on account of the similar pubescence, but *P. Lyallii* is a much smaller plant and with less deeply dissected leaves. It resembles *P. idahoensis* very closely in general habit, but in that species the stamens are only slightly exserted and the corolla smaller. The variety has the same range as the species, but grows usually at a lower altitude. As the type may be taken:

COLORADO: North of Merker, 1902, *Osterhout 2619*.

Lappula Besseyi sp. nov.

Biennial; stem 5–10 dm. high, hirsute, branched above; lower leaves petioled, 6–15 cm. long; blades spatulate or oblanceolate, obtuse, hispidulous and hirsute on the veins; upper leaves sessile, lanceolate; inflorescence branched; bracts small; pedicels in fruit 4–5 mm. long, more or less reflexed; corolla dark blue, scarcely over 1.5 mm. wide; fruit about 3 mm. wide; marginal spines distinct and in one row; back flat, spineless, but minutely hispidulous.

In general habit this species resembles most *L. floribunda*, but is distinguished by the very small flowers and fruit. It grows in cañons at an altitude of about 2400 m.

COLORADO: Cheyenne Cañon, 1895, *E. A. Bessey* (type); also in 1896.

Lappula angustata sp. nov.

Biennial or short-lived perennial; stem strict, hirsute, 6–8 dm. high; lower leaves petioled, 9–15 cm. long, strigose or hirsute on the petioles; blades narrow, linear-oblanceolate, mostly acute; stem-leaves linear-lanceolate, sessile; inflorescence with strongly ascending branches; pedicels reflexed in fruit, about 5 mm. long; corolla blue, about 4 mm. wide; fruit 4–5 mm. wide; marginal

prickles united ⅓–½ their length into a distinct wing, the alternate ones usually much smaller; back slightly keeled, without prickles, minutely hispidulous or glabrous.

In habit this species also resembles *L. floribunda*, but is distinguished by the narrow leaves and the united marginal prickles of the fruit. These characters would place it near *L. scaberrima*, which, however, has a different pubescence.

SOUTH DAKOTA: Oreville, 1902, *Rydberg 891* (type).

COLORADO: La Veta, 1896, *Shear 3640*.

Oreocarya argentea sp. nov.

Cespitose perennial; stems 3–4 dm. high, hispid; basal leaves spatulate or oblanceolate, obtuse, 5–6 cm. long, densely white- or yellowish-pubescent, partly with stiff bristle-like hairs, partly with fine hairs, but all strictly appressed; stem-leaves oblanceolate, with the bristles more spreading; inflorescence narrow and virgate; calyx in fruit 8–10 mm. long, hispid; its lobes linear-lanceolate; corolla white, less than 5 mm. long; its tube included and limb 5–6 mm. wide; nutlets about 3.5 mm. long, papillose and with more or less distinct cross-ridges.

This species is perhaps nearest related to *O. sericea*, which, however, is a much smaller plant and has mammillate-papillose nutlets without cross-ridges. It grows on dry hills in Colorado.

COLORADO: Rifle, Garfield County, 1900, *Osterhout 2122*.

Oreocarya eulophus sp. nov.

More or less cespitose perennial; stem about 2 dm. high, hispid with yellowish hairs; basal leaves numerous, spatulate, 4–5 cm. long, finely cinereous and appressed hispid; stem-leaves oblanceolate, with the hispid hairs more spreading and often yellowish; inflorescence a narrow and almost spikelike thyrsus; calyx in fruit about 7 mm. long, yellowish hispid; its lobes lanceolate; corolla white, 10–12 mm. long; tube exserted from the calyx; limb about 5 mm. wide; nutlets 4–5 mm. long, with irregular honeycomb-like crests.

This species is a near relative of *O. fulvocanescens* and *O. cristata*, but easily distinguished in fruit by its nutlets. It grows on gravelly hills at an altitude of 1800–2300 m.

COLORADO: Dolores, 1892, *Crandall* (type); McCoy's, 1903, *Osterhout 2750*.

UTAH: Price, 1900, *Stokes*.

Mertensia picta sp. nov.

Perennial, perfectly glabrous, except the hispidulous-ciliate margins of the leaves and calyx-lobes; stem 3–5 dm. high, pale and somewhat bluish below, more or less angled; lower leaves petioled; blades oval or elliptic-ovate, 5–9 cm. long, obtuse or acutish, rounded or somewhat truncate at the base, finely pustulate but not hairy on the surfaces, thin; upper leaves lanceolate or ovate-lanceolate and subsessile; inflorescence leafy and with short branches; pedicels and calyx more or less pustulate; calyx-lobes linear-oblong, obtuse, in fruit nearly 2 mm. long, the back with a thickened pale spot; corolla blue; its tube 6–7 mm. long and 2–3 mm. wide; throat and limb together 5–6 mm. long, the latter about 5 mm. wide; filaments dilated, about 2 mm. long and wider than the anthers; nutlets ovate in outline, strongly and irregularly reticulate-crested on the back.

This is closely related to *M. ciliata* but distinguished by the pale-spotted and thickened calyx-lobes.

COLORADO: Estes Park, Larimer County, 1903, *Osterhout 2823* (type); Mount Baldy, 1901, *Clements 288*.

Mertensia polyphylla platensis var. nov.

Like the species, but the calyx-lobes linear, fully 3 mm. long; basal leaves large; blades about 1 dm. long, cordate at the base and cuspidate at the apex.

Along streams at an altitude of 3000 m.

COLORADO: Bob Creek, La Plata Mountains, 1898, *Baker, Earle & Tracy 180* (in part).

Mertensia alba sp. nov.

Perennial; stem pale, 6–8 dm. high, more or less branched; lower leaves petioled, upper sessile; blades lanceolate or elliptic-lanceolate, acute or acuminate at both ends, glabrous beneath, hispidulous-strigose above and on the margins; pedicels and calyx strigose; lobes linear-lanceolate, acute, about half as long as the tube of the white corolla; corolla-tube about 8 mm. long, and 4 mm. wide; throat and limb together of about the same length; the latter 8–10 mm. wide; nutlets irregularly crested-tuberculated, and finely pubescent.

This is a species of the *M. paniculata* group and nearest related to *M. pratensis*, but it lacks the dense white pubescence of the calyx characterizing that species and the corolla in all specimens seen is white.

COLORADO: La Plata River, 1898, *Baker, Earle & Tracy 825*.

Mertensia viridula sp. nov.

Perennial with a cespitose rootstock; stems slender, 2–3 dm. high, glabrous; leaves glabrous beneath, hispid-strigose above; the lower petioled, the upper sessile; blades of the basal ones spatulate, obtuse; those of the stem-leaves acute, elliptic, or the upper lanceolate; pedicels strigose; calyx glabrous, except the base and the margins of the lobes; these broadly lanceolate, about 2.5 mm. long; corolla blue; tube about 4 mm. long; throat and limb of about the same length; filaments broader than the anthers; nutlets muricate and somewhat irregularly ridged.

This species resembles *M. viridis* A. Nels. closely in habit, but the dilated conspicuous filaments associate it with *M. linearifolia* and *M. ovata*, from which it is distinguished by the broader calyx-lobes. It grows in the mountains at an altitude of 2700–3800 m.

COLORADO: North Cheyenne Cañon, 1894, *E. A. Bessey* (type); West Spanish Peak, 1900, *Rydberg & Vreeland 5683*.

Mertensia Parryi sp. nov.

Perennial with a cespitose rootstock; stems about 2 dm. high, glabrous; leaves glabrous beneath, hispidulous-strigose above, only the basal ones petioled and spatulate; stem-leaves sessile, lanceolate or oblanceolate, about 5 cm. long; inflorescence small and short; pedicels strigose; calyx glabrous except the very base and the ciliate margins of the lobes; these narrowly linear-lanceolate, about 3 mm. long; tube of the blue corolla about 5 mm. long and about equaling the length of the throat and limb together; limb about 8 mm. wide; filaments evident but short, broader than the anthers.

This species is nearest related to *M. ovata* Rydb., but differs in the narrower leaves and the comparatively longer corolla-limb. In *M. ovata* the tube is longer than the throat and limb together. *M. Parryi* grows in the higher mountains.

COLORADO: Alpine ridges lying east of Middle Park, *Parry 286* (type); Estes Park, 1903, *Osterhout 2848*; Cameron Pass, 1896, *Baker*; Alpine Tunnel, 1897, *Shear 3853*.

Mertensia perplexa sp. nov.

Perennial with branched rootstock; stem about 3 dm. high, glabrous; basal leaves spatulate, 4–10 cm. long, petioled; stem-leaves sessile; the lower oblanceolate; the upper ovate, glabrous beneath, minutely hispidulous-strigose above; pedicels minutely

hispid-strigose; the hairs with pustulate bases; calyx glabrous except the ciliate margins of the lobes; these oblong-lanceolate, acute or obtuse; corolla blue, about 12 mm. long; tube equaling the throat and limb; the latter 7–8 mm. wide; tube densely villous at the base within; anthers subsessile, inserted a little below the throat.

This species is evidently nearest related to *M. alpina*, notwithstanding the much larger size and erect habit. The corolla is almost twice as long as in that species.

COLORADO: Mountains south of Ward, Boulder County, 1901, *Osterhout 2439*.

Mertensia canescens sp. nov.

Low and cespitose perennial with woody caudex; stems about 1 dm. high, strigose; leaves linear or linear-oblanceolate, grayish strigose on both sides; pedicels and calyx strigose; calyx-lobes linear-lanceolate, acute, about 2 mm. long, on the margin ciliate with longer hairs; corolla blue, about 8 mm. long; tube 1.5 mm. wide and about as long as the throat and the limb, the latter about 3 mm. wide; anthers subsessile at the margin of the corolla-tube.

Closely related to *M. alpina*, it is easily distinguished by the canescent and narrow leaves. It grows on the mountains at an altitude of 3360–3600 m.

COLORADO: Berthaud Pass, 1903, *Tweedy 5664* (type); mountains northwest of Como, 1895, *Cowen 1808*.

Stachys teucriformis sp. nov.

Perennial, 4–6 dm. high; stem round-angled, glandular-villous; lower leaves short-petioled, the upper sessile; blades oblong or oblong-ovate to ovate, cordate or truncate at the base, 5–10 cm. long, crenate, pubescent on both sides; calyx glandular, villous, its lobes linear-lanceolate, long-aristate, about equaling the tube; corolla 12–15 mm. long, light rose, with reddish-purple veins and blotches; upper lip narrow and nearly straight; lower lip large, 3-lobed; lateral lobes triangular; middle lobe rounded-reniform.

The species is closely related to *S. scopulorum*, but differs from it in the larger corolla, the longer calyx-lobes and the usually broader leaves. The type sheet contains two specimens: one of *S. teucriformis* and one of *Teucrium occidentale*, and the two are so alike in foliage that it is hard to distinguish them except by the flowers and bracts.

COLORADO: New Windsor, 1894, *Osterhout* (type); McCoy, 1898, *Shear & Bessey 5302*; Colorado Springs, 1896, *Shear 5189*.

Monardella dentata sp. nov.

Cespitose perennial, somewhat ligneous at the base; stems slender, light brown, about 3 dm. high; leaves short-petioled; blades ovate, 1.5–2 cm. long, serrate-dentate, finely pubescent and strongly punctate, obtuse, strongly veined beneath; heads terminal, solitary, about 1.5 cm. in diameter; bracts lanceolate, obtuse, nearly 1 cm. long, finely canescent, strongly veined, rather thick, of fully as firm structure as the upper leaves; calyx about 8 mm. long, grayish pubescent; lobes lanceolate; corolla about 12 mm. long; its lobes linear, 4 mm. long.

This has been mistaken for *M. odoratissima*, but is easily distinguished by the distinctly toothed leaves and the narrow firm bracts.

COLORADO: Gray's Peak, 1872, *Torrey*.

Solanum interius sp. nov.

Annual, more or less branched; stem 3–6 dm. high, usually with narrow denticulate margins or wings, finely pubescent with short white appressed crisp hairs; leaves with short winged petioles, sparingly pubescent above, usually densely grayish-strigose beneath; blades deltoid or rhombic, 3–7 cm. long, acuminate, usually sinuately lobed or dentate with acute or acuminate lobes or teeth; peduncles 2–4 cm. long, strigose; inflorescence corymbiform, rarely umbelliform; pedicels in fruit about 1 cm. long, recurved but scarcely reflexed; calyx-lobes ovate, 2 mm. long, abruptly acute, in fruit appressed or spreading; corolla yellowish-white; lobes ovate, acute, 3–4 mm. long; filaments very short, less than 0.5 mm. long, glabrous; anthers oblong, about 2 mm. long, yellow, obtuse, opening by terminal pores; berry greenish black, nearly 1 cm. in diameter.

This has gone under the name of *S. nigrum* throughout the interior region where it is a native plant; but the true *S. nigrum* of Europe has almost glabrous leaves with rounded lobes if lobed at all, very obtuse sepals, subumbellate inflorescence and usually reflexed pedicels in fruit. *S. interius* is in reality more closely related to *S. Douglasii*, which, however, differs in the much larger and bluish corolla. It is with some doubt I propose this species as new, as several North American species were described by

Dunal in De Candolle's Prodromus; but our plant does not agree with the description of any of these, except perhaps that of *S. pterocaulon;* a specimen of the latter cited by Dunal is in the herbarium of Columbia University, and this shows that it is more closely related to *S. nodiflorum* than to *S. nigrum.*

S. interius grows in river valleys and on sandy soil among bushes at an altitude of 600–1800 m.

NEBRASKA: On Middle Loup River, near Mullen, 1893, *Rydberg 1385* (type).

KANSAS: Reno County, 1897, *Hitchcock 362-a.*

COLORADO: Near Boulder, 1902, *Tweedy 5236;* Timnath, 1899, *Osterhout;* along Platte River, Denver, 1878, *M. E. Jones 605;* Cañon City, 1896, *Shear 3777;* Bent's Fort, 1846, *Lt. Abert.*

ARIZONA: Chiricehun Mountains, 1894, *Toumey.*

NEW MEXICO: Mesilla, Dona Ana County, 1898, *Wooton 50.*

Pentstemon strictiformis sp. nov.

Perennial with a woody caudex; stems 3–5 dm. high, glabrous and strict, simple; basal leaves petioled, 5–10 cm. long; blades oblanceolate, obtuse, glabrous and slightly glaucous; stem-leaves sessile, lanceolate, acuminate, 4–8 cm. long; inflorescence more or less secund; calyx-lobes lanceolate, acuminate, 8–10 mm. long, more or less scarious and dentate on the margin; corolla violet-purple, funnelform, somewhat gibbous, about 2.5 cm. long and limb nearly 2 cm. wide; anthers long-villous with white hairs; sterile stamen villous with yellow hairs.

This is closely related to *P. strictus,* but differs mainly in the long-acuminate sepals. It grows up to an altitude of 2800 m.

COLORADO: Mancos, 1898, *Baker, Earle & Tracy 76* (type); Gray-Back Mining Camp, 1900, *Rydberg & Vreeland 5630;* Arboles, 1899, *Baker 602.*

Pentstemon oreophilus sp. nov.

Perennial branched at the base, perfectly glabrous throughout, 2–4 dm. high; basal leaves oblanceolate, obtuse, short-petioled; stem-leaves lanceolate and sessile, 5–10 cm. long, acute or acuminate; inflorescence dense and usually more or less one-sided, calyx 8–10 mm. long; lobes lanceolate, long-acuminate with toothed scarious auriculate sides; corolla funnelform, more or less gibbous, bluish purple, 12–15 mm. wide at the mouth; lower lip

more or less bearded within; anthers hispidulous on the margin and more or less short-hairy on the back and sides; sterile stamen with yellow beard at the end.

This is closely related to *P. glaber* and *P. alpinus*, differing from the former in the lower habit and the shape of the calyx-lobes, which in *P. glaber* are orbicular or short ovate and with very scarious erose margins. *P. alpinus* Torr. (= *P. riparius* A Nels.), is more or less puberulent throughout. *P. oreophilus* grows at an altitude of 1800–3600 m.

COLORADO: Eldora to Baltimore, 1903, *Tweedy 5711* (type) and *5710*; Halfway House, 1896, *Shear 4781*; Manitou, 1896, *Clements 171*; Larimer County, 1893, *Crandall*; Quartz Ridge, Pike's Peak, *Clements 113*; South Cheyenne Cañon, 1895, *E. A. Bessey*; mountains near Empire, 1892, *Patterson 256*.

Pentstemon cyathophorus sp. nov.

Perennial and more or less cespitose at the base, glabrous throughout or the basal leaves minutely puberulent; stem very strict, 3–4 dm. high; basal leaves spatulate, petioled, 3–6 cm. long; lower stem-leaves also spatulate; the others ovate or orbicular, often abrubtly acuminate or mucronate; bracts round, ovate or orbicular, abruptly short-acuminate, the upper usually scarious-margined and erose, reniform and the pairs together resembling a cup; calyx 6–8 mm. long; lobes lanceolate, scarious-margined and more or less erose-dentate; corolla pink-purple, a little over 12–15 mm. long, more or less open-funnelform from a narrow tube, little oblique and scarcely gibbous; anthers glabrous; sterile stamen spatulate at the apex and with a yellow beard.

This is closely related to the northern *P. acuminatus* and has been mistaken for it, but differs in the scarious-margined and toothed calyx-lobes and upper bracts. It grows in mountain meadows at an altitude of 2500–3000 m.

COLORADO: Pearl, 1901, *Tweedy 4307* (type); Grizzly Creek, 1896, *Baker*; also 1894, *Crandall 1438*; North Park, 1896, *Osterhout 59*; also 1891, *Crandall 1439*.

Castilleja brunnescens sp. nov.

Perennial with a short cespitose caudex; stems 3–5 dm. high, more or less pubescent and purplish; leaves narrowly linear-lanceolate, more or less distinctly 3-nerved, 4–5 cm. long, finely pubescent; bracts ovate to oblong-lanceolate, obtuse or rounded

at the apex, entire or with a short tooth on each side, tinged with pale brown; calyx about 2 cm. long, densely and finely pubescent, cleft about equally deep in front and on the back; each division with 2 lanceolate lobes, about 3 mm. long; corolla about 3 cm. long; upper lip about 1 cm. long; lower about 3 mm.

This species may be most closely related to *C. confusa* Greene, but is easily distinguished by the light brownish color of the obtuse bracts. On account of this light color the type-specimens were labeled *C. pallida*, which it resembles somewhat but has an altogether different corolla. It grows in the mountains at an altitude of 2700–3300 m.

COLORADO: Cameron Pass, 1896, *Baker* (type); Gray's Peak, 1871, *Porter*; Red Mountain, south of Ouray, 1901, *Underwood & Selby 293*; Pike's Peak, 1894, *E. A. Bessey*.

Castilleja obtusiloba sp. nov.

Perennial with a very short caudex; stem very sparingly hairy, 3–4 dm. high; lower leaves oblong-lanceolate, 3-nerved, minutely pubescent, 3–4 cm. long, entire; the upper broader, 3-cleft; lateral lobes lanceolate; the middle one oblong, obtuse; bracts similar, but broader, purple; middle lobe elliptic, rounded at the apex; calyx about 2.5 cm. long, almost equaling the corolla, equally deeply cleft in front and on the back; lobes short, oblong and rounded at the apex; corolla yellowish and purple-tinged; upper lip nearly 1 cm. long; lower nearly 3 mm.

This species is perhaps a near relative of *C. rhexifolia* and *C. confusa*, but easily distinguished by the peculiar bracts and short and very obtuse calyx-lobes. It grows at an altitude of about 2700 m.

COLORADO: Leroux Park, Delta County, 1892, *Cowen*.

Castilleja puberula sp. nov.

Perennial with a short cespitose caudex; stems less than 1 dm. high, finely puberulent; leaves 2–3 cm. long, pinnately divided into linear lobes or entire and linear, finely puberulent; bracts similar, but shorter and broader, tinged with yellowish, often more villous; calyx more or less villous, 1–1.5 cm. long, deeper cleft in front than on the back; lobes lanceolate, acute; corolla yellowish, 18–20 mm. long; upper lip 6–8 mm. long; lower lip 3–4 mm., very gibbous.

This species has been taken for *C. brachyantha* Rydb. (*C. brevi-*

flora A. Gray); but that species is a much taller plant and the galea is about three times as long as the lower lip. It grows at an altitude of 2500–3600 m.

COLORADO: 1872, *Parry* (type, in herb. Columbia University): Empire, 1903, *Tweedy 5742*; Berthoud Pass, 1903, *Tweedy 5741*.

Valeriana trachycarpa sp. nov.

Perennial with a thick fleshy root; stem glabrous or nearly so, 5–7 dm. high; basal leaves oblanceolate or spatulate, 7–18 cm. long, finely puberulent, especially on the margins and veins; entire or with a few linear lobes, thick; stem-leaves 1–2 pairs, pinnatifid with linear lobes; inflorescence large and branched; corolla of the staminate plant 2.5–3 mm. wide; that of the essentially pistillate plant about 1.5 mm. wide; fruit broadly ovate, not hairy, but strongly rugose.

This is closely related to *V. edulis* and *V. purpurascens*, but the former has pubescent ovary and fruit and narrower bracts, and the latter has narrower fruit, narrower leaves, more slender inflorescence and smaller staminate flowers, only 2 mm. wide; *V. trachycarpa* grows at an altitude of 2500–3000 m.

COLORADO: Red Mountain, 1901, *Underwood & Selby 352* (type); Alpine Tunnel, *441*; Marshall Pass, 1901, *Baker 481*; Rabbit Ears Pass, 1896, *Baker*.

NEW MEXICO: White Mountains, 1897, *Wooton 320*.

Valeriana ovata sp. nov.

Perennial with a rootstock; stem about 3 dm. high, glabrous; basal leaves entire, petioled, glabrous; petioles 2–6 cm. long; blades ovate, usually truncate or slightly cordate at the base, acute, entire or sinuate; stem-leaves 2–3 pairs; lateral lobes oblong to linear-lanceolate; the terminal one lanceolate or of the lower leaves elliptic; inflorescence small and corymbiform; corolla funnelform-salvershaped, about 8 mm. long; limb of the fertile flowers about 4 mm. wide; of the staminate ones about 6 mm. wide; fruit ovate, glabrous.

This species belongs to the *V. septentrionalis* group, but is characterized by its basal leaves. It grows on wooded hillsides at an altitude of 2400–2900 m.

COLORADO: Cameron's Cove, 1901, *Clements 241* (type).

NEW MEXICO: Cañon four miles east of Santa Fé, 1897, *Heller 3613*; Elizabeth Town, 1897, *Berg*.

Coleosanthus albicaulis sp. nov.

Brickellia Wrightii and *B. californica* A. Gray, Syn. Fl. 1[2]: 106; both in part. 1884.

Shrubby at the base, 0.5–1 m. high; bark of the older wood brownish, striate and fissured, that of the younger branches straw-colored or grayish, hirsute-puberulent, more or less flaky; leaves short-petioled; blades broadly cordate, 2–5 cm. long, strongly veined, thick, scabrous-puberulent, crenate-dentate; inflorescence consisting of small axillary clusters scarcely exceeding the leaves, of 2–6 heads on short peduncles; heads 10–20-flowered; involucres turbinate; lower bracts short-ovate, the inner linear, all acutish or obtuse, greenish straw-color; corolla cream-color; pappus white.

This has been confused mostly with *C. Wrightii*, but the type of that species has more ovate leaf-blades, longer petioles, longer flower clusters, which exceed the leaves, and purple-tinged involucre, the bracts of which are very obtuse or rather rounded at the apex. It is rather nearer **Coleosanthus reniformis** (*Brickellia reniformis* A. Gray); from which it differs mainly in the longer, cordate, not reniform leaf-blades and larger and sharper teeth. It grows on the foothills and in cañons at an altitude of 1500–2500 m.

COLORADO: Manitou, 1900, *Clements* (type); Larimer County, 1891, *Cowen;* Lower Boulder Cañon, 1901, *Osterhout 2411;* Spring Cañon, 1897, *Crandall 2785;* Manitou, 1896, *Shear 4589;* Golden, 1895, *Shear 3261;* Mount Harvard, 1896, *Clements 63;* Golden, 1895, *Rydberg;* Boulder, 1885, *Letterman.*

UTAH: Salt Lake City, 1880, *M. E. Jones 1921;* Wahsatch Mountains, 1869, *Watson 495;* Provo, 1887, *Tracy & Evans 709.*

Grindelia serrulata sp. nov.

Biennial or perhaps short-lived perennial; stem glabrous, about 6 dm. high; leaves sessile, oblanceolate or oblong, acutish, very viscid, 3–5 cm. long, finely and densely serrate; inflorescence corymbiform; involucre very viscid, about 15 mm. broad; bracts subulate, very squarrose and reflexed; ligules 7–8 mm. long, 1–1.5 mm. wide; pappus-awns apparently smooth; barbules seen only under a compound microscope.

This is nearly related to *G. perennis* and *G. squarrosa.* From the former it differs in the closely and sharply toothed leaves, and from the latter in the oblanceolate instead of ovate or oval leaves.

grows on plains at an altitude of about 1500 m.

COLORADO: Fort Collins, 1891, *Cowen* (type); Denver, 1869, *B. H. Smith.*

Grindelia aphanactis sp. nov.

Apparently perennial; stem 3–4 dm. high, glabrous and striate; leaves very viscid, oblanceolate, acute, 4–7 cm. long, sharply dentate and sessile, or the lower more or less pinnatifid and petioled; inflorescence corymbiform; heads about 15 mm. broad; bracts very viscid, subulate; all very squarrose and the lower reflexed; rays none; awns of the pappus apparently smooth.

This species has been confused with *G. nuda* Wood, but that species has broad leaves and large heads and resembles in general habit more the radiate *G. squarrosa*. *G. aphanactis* grows in gravelly soil.

COLORADO: Durango, 1898, *Baker, Earle & Tracy 526* (type).

NEW MEXICO: Lincoln, *Earle.*

Gutierrezia linearis sp. nov.

Shrubby and branched; leaves linear, about 3 cm. long, 1–2 mm. wide, puberulent and viscid, punctate; heads 5–6 mm. high; involucres campanulate, slightly turbinate at the base; bracts scarious-margined; the outer ovate or obovate, the inner elliptic, obtuse; inflorescence corymbiform; ray- and disk-flowers each 3–4.

This species resembles *G. longifolia* in habit but has the head of *G. diversifolia*. It grows at an altitude of 1800–2300 m.

NEW MEXICO: Gray, Lincoln County, 1900, *Earle 474* (type).

COLORADO: Gunnison, 1901, *Baker 821;* Red Rock Cañon, 1896, *E. A. Bessey.*

Gutierrezia scoparia sp. nov.

Woody only at the base; flowering herbaceous branches numerous, about 3 dm. high, puberulent, mostly simple up to the inflorescence; leaves linear, 3–5 cm. long, 1–2 mm. wide, puberulent; inflorescence corymbiform; involucre oblong-turbinate, over 5 mm. high; outer bracts lanceolate, inner oblong; disk- and ray-flowers each about 4.

This is closely related to *G. diversifolia*, but has a longer, more turbinate involucre and narrower bracts. It grows at an altitude of 1500–2100 m.

COLORADO: Manitou, 1901, *Clements 16* (type); Boulder, 1902, *Tweedy 4888.*

Chrysopsis caudata sp. nov.

Perennial, with a thick tap-root and a very short, erect and much-branched caudex; stems many, erect, purplish, hirsute with long white hairs; lower leaves oblanceolate, tapering into a short petiole, silky-strigose on both sides, 3–5 cm. long; middle leaves similar but sessile, uppermost elliptic or oblong; heads congested in small clusters at the end of the branches and subtended by the uppermost leaves; bracts linear-lanceolate, hirsute, the innermost with a subulate usually brownish and spreading tip; disk about 15 mm. wide; rays bright yellow, about 12 mm. long and 3 mm. wide.

This species is closely related to *C. villosa*, but differs in the sessile heads subtended by oblong leaves and in the subulate tips of the involucral bracts. It grows on hills at an altitude of 1500–2950 m.

COLORADO: Ruxton Dell, 1901, *Clements 143* (type); near Boulder, 1902, *Tweedy 4897*.

Chrysopsis amplifolia sp. nov.

Perennial, with a tap-root, rather simple; stem 3–5 dm. high, often branched, pubescent and sparingly hirsute; lower leaves spatulate, strigose, obtuse or slightly mucronate, middle and upper leaves broadly oblong or elliptic; the upper cordate or truncate at the base, 3–4 cm. long, 12–15 mm. wide; inflorescence corymbiform; heads usually subtended by oblong leaves; bracts hirsute-strigose, linear-lanceolate, acute; disk 15 mm. or more wide; rays golden yellow, about 12 mm. long and 2.5 mm. wide; achenes densely strigose-canescent.

This is also closely related to *C. villosa*, but distinguished by the ample upper stem-leaves with subcordate or truncate bases and the large sessile heads. It grows on plains and foothills at an altitude of about 1500 m.

COLORADO: Longmont, 1902, *Tweedy 4898* (type); Ward, 1901, *Osterhout 2444*.

Chrysopsis horrida sp. nov.

Perennial with a tap-root, more or less cespitose; stems about 2–3 dm. high, hirsutulous and hispid, more or less branched, especially above; leaves obovate, broadly oblanceolate or oblong, subsessile, except the lower, densely hirsute with short hairs and slightly glandular-puberulent; heads corymbose, peduncled, about 8 mm. high; disk 1 cm. or less wide; rays about 8 mm. long and 1–1.5 mm. wide; achenes 2 mm. long, canescent; pappus about 5 mm. long, yellowish.

This has been taken for *C. hispida*, but the original *Diplopappus hispidus* Hook. is less hairy with longer hairs and more viscid; the leaves are narrowly oblanceolate and petioled and the heads larger, the disk being 12–15 mm. wide. *C. horrida* grows on dry hills and plains at an altitude of 1200–1600 m.

COLORADO: New Windsor, 1900, *Osterhout 2326* (type), and 1901, *2362*; Platte, *Frémont*.

NEBRASKA: Pumpkin Seed Valley and Lawrence Fork, 1891, *Rydberg 141*.

Chrysopsis alpicola sp. nov.

Cespitose perennial; stems about 1 dm. high, silky-villous, numerous; leaves oblanceolate, about 3 cm. long; nearly all petioled, white-silky strigose or the pubescence more spreading on the petioles; heads solitary, subsessile, about 1 cm. high; bracts linear-lanceolate, hirsute, acute; disk about 12 mm. in diameter; rays about 8 mm. long and 2 mm. wide; achenes white silky-hirsute.

This is perhaps most closely related to *C. Bakeri*, but is much lower, more silky, with sessile heads and more hirsute involucre. It grows on the higher mountains, at an altitude of about 3500 m.

COLORADO: Clark's Peak, 1896, *Baker*.

Solidago rubra sp. nov.

Stout, about 3 dm. high; stem pubescent or at the base merely puberulent, reddish; basal and lower cauline leaves broadly oblanceolate, 6–12 cm. long, firm, bluish-green, glabrous, pinnately veined, serrulate and minutely scabrous on the margins, acute, petioled; upper stem-leaves sessile and lanceolate; inflorescence paniculate but very narrow and elongated; heads about 8 mm. high. and as broad; bracts narrowly linear-lanceolate, acute, ciliolate on the margin; rays rather pale yellow, about 4 mm. long and 0.7 mm. wide; achenes strigose.

This species is related to *S. scopulorum*, but is distinguished by the stouter habit, the broad leaves, the compound and dense inflorescence.

COLORADO: North Park, 1899, *Osterhout 5*.

Solidago laevicaulis sp. nov.

Rather tall, 4–7 dm. high; stem glabrous up to the inflorescence, light-colored and shining; basal leaves narrowly oblanceo-

late, indistinctly if at all triple-nerved, rather thin, obtuse, 5–10 cm. long, entire or crenate above, glabrous except the scabrous margin; lower stem-leaves similar; upper stem-leaves narrowly lanceolate, sessile; inflorescence paniculate, but rather narrow, with numerous heads; branches nearly erect; heads about 8 mm. high; bracts narrowly linear-lanceolate, acute, ciliolate on the margin; disk about 8 mm. wide; rays numerous, about 4 mm. long and nearly 1 mm. wide; achenes sparingly strigose.

This is nearest related to the preceding, but taller and more slender, with narrower leaves and glabrous stem. It approaches the *S. serotina* group but has neither triple-nerved leaves nor secund branches. It grows in the mountains of Colorado and southern Wyoming at an altitude of 2500–3300 m.

COLORADO: North Park, 1899, *Osterhout 4* (type); Berthoud Pass, 1903, *Tweedy 5857*.

WYOMING: Copperton, 1901, *Tweedy 4009*.

Solidago radulina sp. nov.

Perennial; stem 3–4 dm. high, grayish-puberulent; basal and lower cauline leaves spatulate, obtuse, crenate at the apex, finely puberulent; upper stem-leaves elliptic or spatulate, acute; inflorescence narrow and elongated, paniculate; heads about 4 mm. high; bracts oblong, obtuse, or the inner linear, ciliolate on the margin; rays about 2.5 mm. long, 1 mm. wide; achenes hirsutulous.

This species is intermediate between *S. nana* and *S. pulcherrima*, but differs from the former in the taller habit and the elongated inflorescence and from the latter in the broader and shorter stem-leaves. In leaf-form it resembles somewhat *S. radula*, but is a smaller plant, with smaller leaves and narrow inflorescence, the branches of which are short and only somewhat secund. The type grew at an altitude of 1800 m.

UTAH: Cottonwood Cañon, 1869, *Watson 558* (type in herb. Columbia University).

COLORADO: Meadow Park, 1895, *Shear 5049*.

Solidago serra sp. nov.

Perennial with a rootstock; stem simple up to the inflorescence, about 6 dm. high, more or less pubescent especially above; leaves lanceolate, about 8 cm. long, acuminate, sharply toothed, rather

thin, glabrous on both sides; inflorescence paniculate; branches arching and secund; heads numerous, 3–4 mm. high; bracts linear or linear-lanceolate, acute; rays 1–1.5 mm. long, less than 0.5 mm. wide; achenes hirsutulous.

This is closest related to *S. canadensis*, but differs in the glabrous leaves and the less pubescent stem. It may also be confused with *S. serotina* and *S. elongata*, but the former has much larger heads, fully 5 mm. high, and in the latter the inflorescence is narrower, rhombic in outline and with ascending scarcely arched branches.

COLORADO: Yampa, 1898, *Shear & Bessey 5274* (type).

WYOMING: Copperton, 1901, *Tweedy 4007*.

Solidago polyphylla sp. nov.

Tall, sometimes a meter high; stem strict, simple and puberulent up to the more hirsutulous inflorescence; leaves narrowly lanceolate, sessile, acute at the base, acuminate at the apex, distinctly triple-nerved, serrate above the middle with small distant teeth, thick and firm, green, scabrous above, more softly short-pubescent beneath; inflorescence panicled; branches more or less arching and secund; heads about 5 mm. high; bracts linear, acute; rays 1.5–2 mm. long, 0.5 mm. wide; achenes hispidulous.

This species is closely related to *S. procera* and has been mistaken for it. It differs from that species in the larger heads (in *S. procera* only 3–4 mm. high), the more compact inflorescence, the more toothed upper leaves and the shorter pubescence on the stem and lower leaf-surfaces.

COLORADO: Cañon City, 1896, *Clements 295* (type); Gunnison, 1901, *Baker 899*; Engelmann Cañon, 1901, *Clements 400*.

NEW MEXICO: Roswell, 1900, *Earle 346*.

Solidago viscidula sp. nov.

Low, about 2 dm. high; stem finely pubescent, reddish; basal leaves and lower stem-leaves narrowly linear-oblanceolate, finely puberulent and somewhat viscid, denticulate, obtuse or acutish, indistinctly triple-veined; upper stem-leaves sessile; inflorescence paniculate but flat-topped, branches scarcely secund; heads numerous, small, about 5 mm. high; bracts linear, obtusish, viscid; rays pale, about 2 mm. long and 0.5 mm. wide.

This is closely related to *S. missouriensis*, but is distinguished by the viscid inflorescence and the indistinctly triple-nerved leaves.

COLORADO: Grand Lake, 1888, *Holway*.

Oligoneuron canescens sp. nov.

Solidago rigida humilis Porter Syn. Fl. Colo. 63, 1874. Not *S. humilis* Mill.

Stout perennial; densely yellowish-canescent throughout; stem simple up to the inflorescence, 5–7 dm. high; basal leaves long-petioled; blades oval, 7–12 cm. long, thick, canescent on both sides, in age scabrous, distantly crenulate with small callous teeth; upper stem-leaves oval, sessile, entire or sinuate, crenulate, very densely canescent; inflorescence corymbiform but much congested; heads about 1 cm. high; bracts oblong, striate, canescent; rays 3–4 mm. long, less than 1 cm. wide, light yellow; achenes slightly hairy above, otherwise glabrous.

This differs from *O. rigidum* Small (*Solidago rigida* L.) in the shorter leaves, the smaller and denser inflorescence, the dense yellowish-canescent pubescence, and the achenes which are apparently always slightly hairy above. It grows on prairies and in valleys at an altitude of 900–1800 m.

WYOMING: Buffalo, 1900, *Tweedy 3117* (type); Dayton, 1899, *Tweedy 2017*; Devil's Tower, 1899, *L. W. Carter*.

NEBRASKA: Plummer Ford, Dismal River, 1892, *Rydberg 1666*.

SOUTH DAKOTA: Custer, 1892, *Rydberg 769*.

NORTH DAKOTA: Tower, 1891, *Wright*.

Chrysothamnus patens sp. nov.

Shrubby, half a meter or so high; stems white-tomentulose when young, soon glabrous and yellowish green; leaves 6–8 cm. long, about 1 mm. broad, soon glabrous, spreading or even reflexed; bracts lanceolate, acute, carinate, glabrous, in 5 vertical rows of about 3 each; corolla-lobes about 1 mm. long, lanceolate, acute, in age more or less spreading; achenes strigose.

This is closely related to *C. graveolens*, but differs in the narrow, spreading leaves. It grows on dry hills at an altitude of 1300–2100 m.

COLORADO: 1873, *Wolf 452* (type); Grand Junction, 1901, *Underwood & Selby 498b*; 1900, *Stokes*; Manitou, 1900, *Clements*; Alamosa, 1896, *Shear 3753*; Zola, 1901, *Baker 668*.

Chrysothamnus Newberryi sp. nov.

Shrubby below; stem white-tomentose, rather slender; leaves erect, linear-filiform, 1-nerved, slightly tomentulose when young;

the upper smaller; involucres turbinate; bracts in about 5 vertical rows, usually 3 in each row, narrowly lanceolate, attenuate into a long slender subulate spreading tip, carinate, slightly tomentulose and webby; achenes narrow, tapering downwards, strigose-pubescent; corolla narrowly tubular-funnelform; lobes erect, lanceolate.

This species is closely related to *C. Parryi* and *C. Howardi*, but the former differs in the broad, 3-nerved leaves and broader bracts, and the latter by its spreading arcuate leaves, broader bracts, depressed habit and elongated upper leaves, which usually equal or exceed the heads. *C. Newberryi* grows on dry hills.

NEW MEXICO: Cañon Largo, 1859, *Newberry* (Macomb's Expedition; type in herb. Columbia University).

COLORADO: Mesa Verde, 1892, *Eastwood*.

Sideranthus annuus nom. nov.

Aplopappus rubiginosus A. Gray, Syn. Fl. 1^2: 130. 1884. Not Torr. & Gray, Fl. **2**: 240. 1842.

A little comparison between the descriptions of *A. rubiginosus* in Torrey and Gray's Flora and in Gray's Synoptical Flora will show that they are drawn from different plants. The first line in Torrey and Gray's description, viz. "suffruticose? branching from the base, viscidly pubescent and cinereous" and further down "scales of the involucre . . . in about 2 series, nearly equal, loose, at length spreading" do not at all fit the plant of the upper Platte, for that plant is strictly annual, simple at the base and branched above, viscid but can hardly be called cinereous; the bracts are in 4 or 5 series, well imbricated and the outer much shorter. The type of *Aplopappus rubiginosus* was collected by Drummond, and a specimen is in the Gray herbarium. This is very unlike the plant of the upper Platte region, which is described in Gray's Synoptical Flora, but agrees fully with the description of Torrey and Gray. It is more closely related to *A. phyllocephalus* DC., but perhaps distinct.

Aster griseolus sp. nov.

Perennial with a horizontal rootstock; stem 1–1.5 dm. high, hirsute with ascending hairs, rather simple; leaves linear, 3–5 cm. long, sparingly hairy on both sides, sessile, acute, entire; heads about 1 cm. high, 1–4 in a small corymb; bracts oblanceolate or

linear, the outer obtuse, the inner acute, green or the inner white on the sides below, pubescent on the back, but not bristle-pointed; rays purple, about 8 mm. long and 1 mm. wide; achenes pubescent.

This is nearest related to *A. griseus* Greene, but differs in the small size, the narrow short sessile leaves, and the pubescence which is not reflexed on the lower part of the stem. *A. griseolus* grows on the higher mountains of Colorado.

COLORADO: Mt. Harvard, 1896, *Clements 37* (type); Twin Lakes, 1896, *Shear 3499*.

Aster Underwoodii sp. nov.

Perennial with a horizontal rootstock; stems simple up to the inflorescence, 2–3 dm. high, often purplish, more or less hirsute-strigose; lower leaves spatulate or oblanceolate, tapering into a winged petiole, glabrous except the ciliolate margin or slightly pubescent when young; the other stem-leaves sessile and the uppermost linear-lanceolate; inflorescence racemiform or corymbiform with 4–8 heads; these fully 1 cm. high; bracts oblanceolate, the outer obtuse, the inner acutish, all with a rather thick green tip, pubescent on the back; rays purple or bluish, about 1 cm. long and 1–1.5 mm. wide; achenes hirsute.

This is related to *A. adscendens* and *A. Nelsonii*. From the former it differs in the hairy bracts and from the latter in the broad leaves. It suggests also *A. griseus*, but has shorter and almost glabrous leaves. It grows at an altitute of 2500–3000 m.

COLORADO: Ironton Park, 1901, *Underwood* and *Selby 318* (type); Eldora to Baltimore, 1903, *Tweedy 5831*.

Aster Osterhoutii sp. nov.

Tall, branched and leafy, about 1 mm. high; stem striate, glabrous below, hairy in decurrent lines above; leaves linear or linear-lanceolate, 5–12 cm. long, 8 mm. wide or less, scabrous-ciliolate on the margin, otherwise glabrous, entire-margined, sessile and half clasping; those of the branches much smaller; inflorescence open-paniculate; heads nearly 1 cm. high; bracts in 4–5 series, the inner linear, acute, the outer oblanceolate, apiculate, green and with white margins below; rays white or rarely pinkish, nearly 1 cm. long and fully 1 mm. wide.

This species is related to *A. salicifolius*, but differs in the narrow, thin, entire leaves. Mr. Fernald, to whom some of the specimens had been sent, named it *A. salicifolius caerulescens* Gray, but that

has very narrow, linear outer bracts and usually purplish or bluish rays. *A. Osterhoutii* grows along ditches at an altitude of about 1500 m.

COLORADO: New Windsor, 1899, *Osterhout 2506* (type); also 1898, *9*, and 1900, *2328*.

Aster corymbiformis sp nov.

About 3 dm. high; stem strict, branched above, pubescent on decurrent lines; leaves linear, 5–8 mm. long, scabrous on the margins, otherwise usually perfectly glabrous, half-clasping; inflorescence leafy, corymbiform; heads about 8 mm. high; bracts linear-lanceolate, very acute, glabrous, rather firm, with an oblanceolate green tip, in about 3 series of nearly equal length; rays white or purplish, about 7 mm. long and 1 mm. wide.

This is perhaps nearest related to *A. paniculatus*, but in habit reminding somewhat of *A. adscendens*. From the former it differs in the strict habit, the corymbiform inflorescence and the entire leaves. From *A. adscendens* it differs in the more numerous heads and the bracts, the outer of which at least are oblanceolate and obtuse in *A. adscendens*.

COLORADO: West Cliff, 1896, *Shear 3460* (type); also *3813* and *3819*; Parlin, Gunnison Co., 1901, *B. H. Smith 114* and *116* (?).

Aster Tweedyi sp. nov.

Perennial with a horizontal rootstock; stem simple, usually purplish, pubescent only on decurrent lines, about 4 dm. high; leaves oblanceolate, acute, glabrous except the ciliate margin, rather firm, often 1 dm. long; the lower with a winged petiole; the upper sessile and half clasping; inflorescence paniculate, leafy; heads about 1 cm. high; bracts in about 3 series, linear or oblanceolate, not very unequal in length, the outer mostly green and obtuse, the inner with green tips and midrib, whitish on the sides below; rays rose or purple, 8–10 mm. long and 1.5 mm. wide.

This species is related to *A. adscendens* but differs in the stouter habit, broader and firmer leaves and larger heads. It grows in valleys at an altitude of 1500–2600 m.

WYOMING: Copperton, 1901, *Tweedy 4096* (type); Big Horn Mountains, 1899, *Tweedy 2523*; Laramie, 1897, *Elias Nelson 152*.

COLORADO: Laramie River, Larimer County, 1897, *Osterhout 2518*.

A new Asplenium from Mexico*

WILLIAM R. MAXON

For nearly twenty years the specimen described below has lain among the undetermined material of *Asplenium* in the United States National Herbarium. Recent studies in this genus have failed to discover any species to which it may be referred, and the writer has come to the conclusion that it represents a species hitherto unnoticed. It may be known as:

Asplenium modestum sp. nov.

Fronds 5, about 8 cm. high, borne from a stoutish suberect rhizome: stipes 0.5–2.3 cm. long, naked, greenish, sulcate: laminae 4.5–6 cm. long by 1.5 cm. broad, somewhat coriaceous, oblong-lanceolate, with six to eight pairs of subopposite to alternate, distant to close-set, short-stalked pinnae; pinnae ovate-deltoid to irregularly rectangular, broadly excised below, the lowermost pinnately parted into three cuneate lobes (the superior, and in some cases the inferior, quite free), which in turn are deeply and sharply cleft, the margins thus coarsely and unequally fimbriate; succeeding pinnae less deeply parted, commonly only the superior lobe free; venation obscure, subflabellate-pinnate: sori rather short, two or three to each lobe; indusia suberose, partially concealed by the mature sporangia.

Asplenium modestum, natural size.

Founded upon a single sheet, *no. 27674*, in the United States National Herbarium, collected in southwestern Chihuahua, Mexico, August to November, 1885, by Dr. Edward Palmer (*no. 162*). The type sheet bears two plants, one fully mature which may stand as the type, and a second plant which though very young is without doubt the same.

* Published by permission of the Secretary of the Smithsonian Institution.

Asplenium modestum is apparently an aberrant member of the *lanceolatum* group of Hooker and Baker's Synopsis Filicum, its nearest Mexican allies being, perhaps, *A. micropteron* Baker and *A. Glenniei* Baker, the latter hardly distinct from the Asiatic *A. exiguum* Bedd. From these, however, it differs conspicuously in many particulars, but notably in its wholly green stipes and in its broad divided pinnae, the lowermost scarcely at all reduced. The flabellate aspect of the pinnae is pronounced and should serve at once to distinguish the species.

The writer is indebted to Mr. H. D. House for the accompanying drawing, which represents at natural size one of the five fronds of the type-specimen before mentioned.

UNITED STATES NATIONAL MUSEUM.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omission their kindness will be appreciated.

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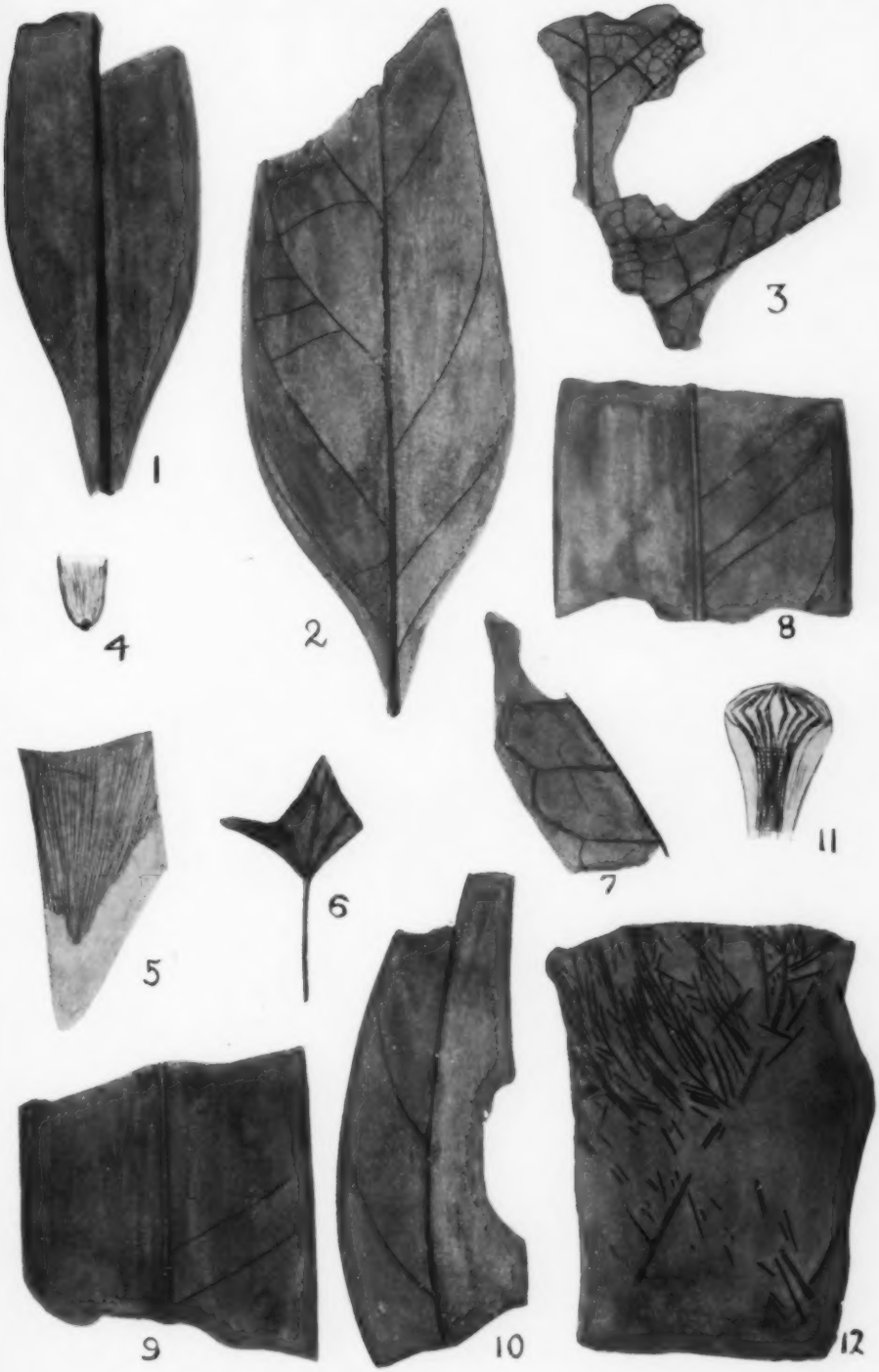

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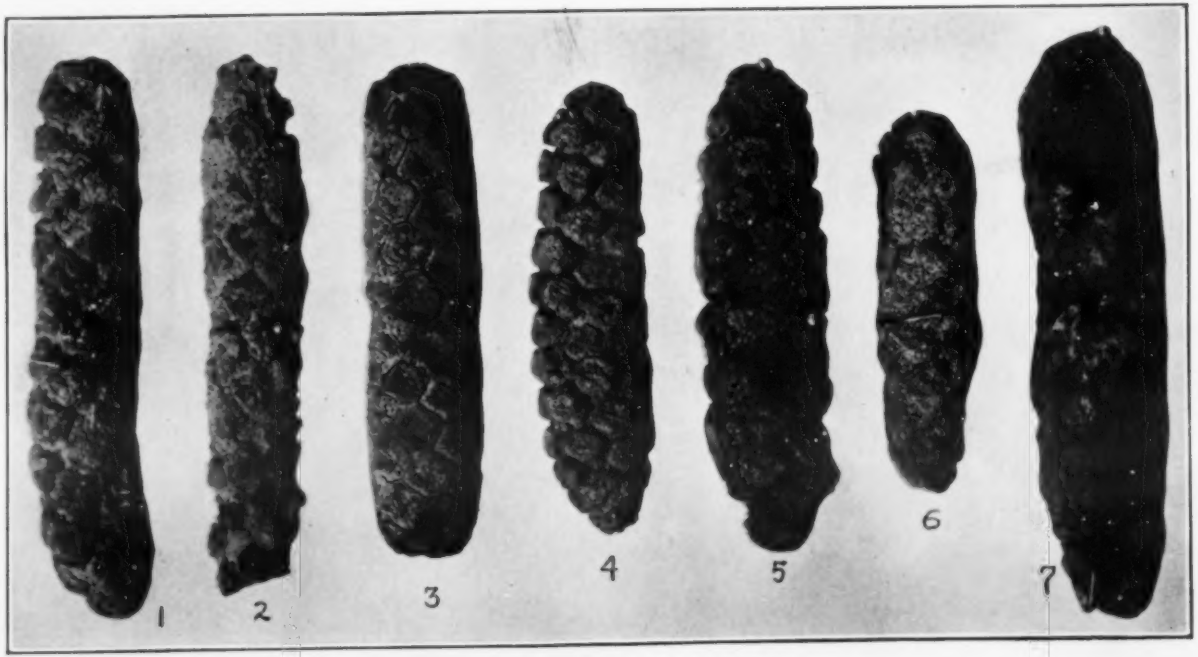

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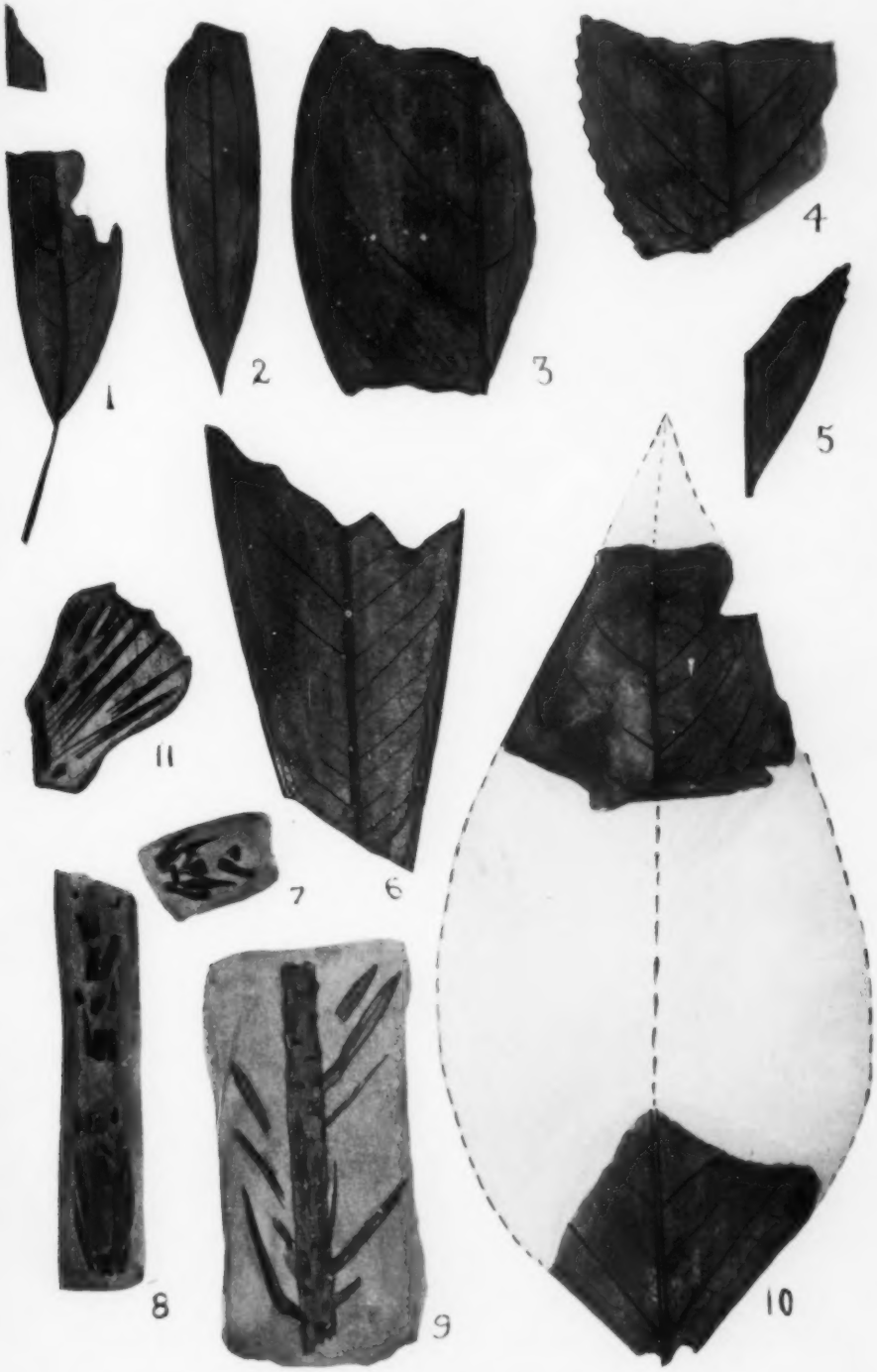

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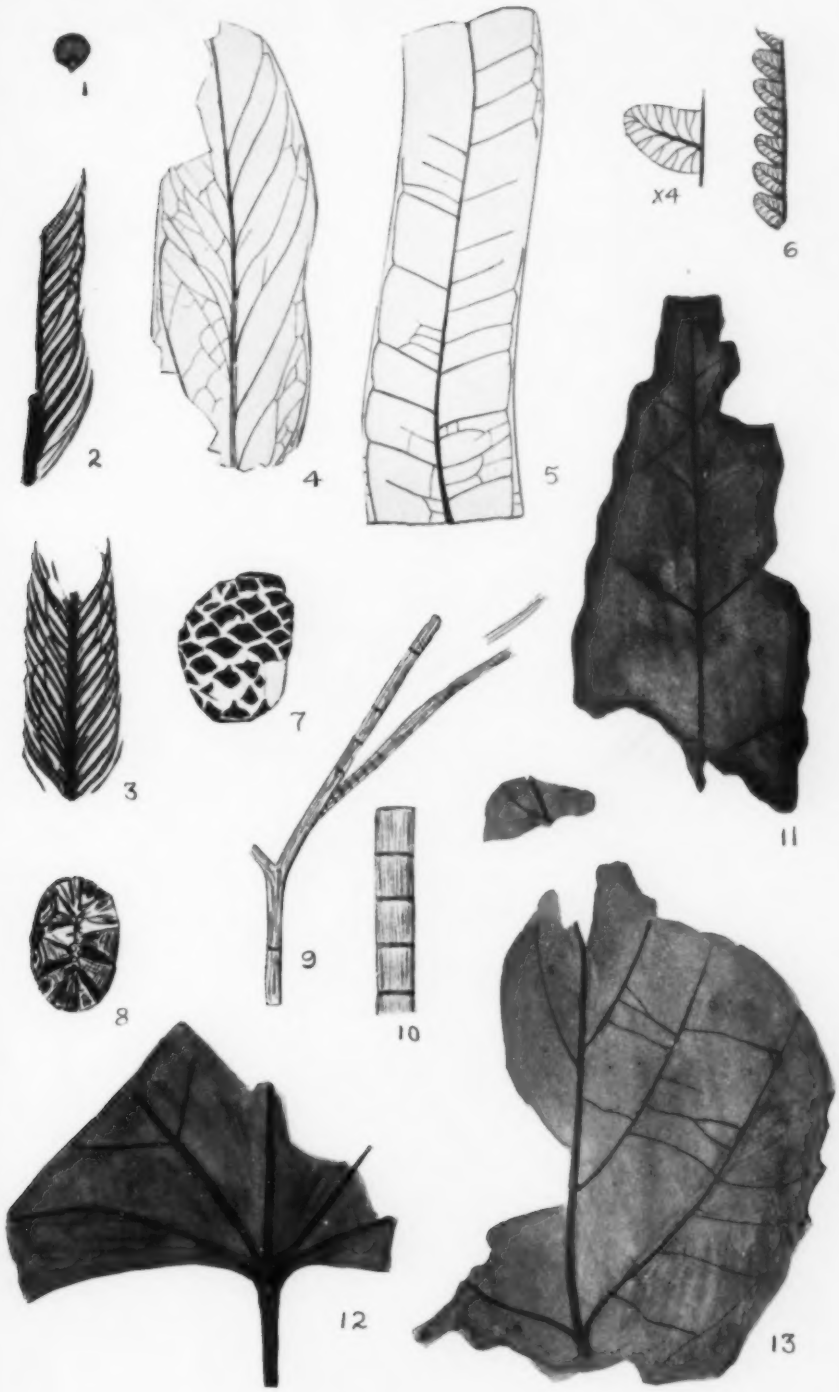

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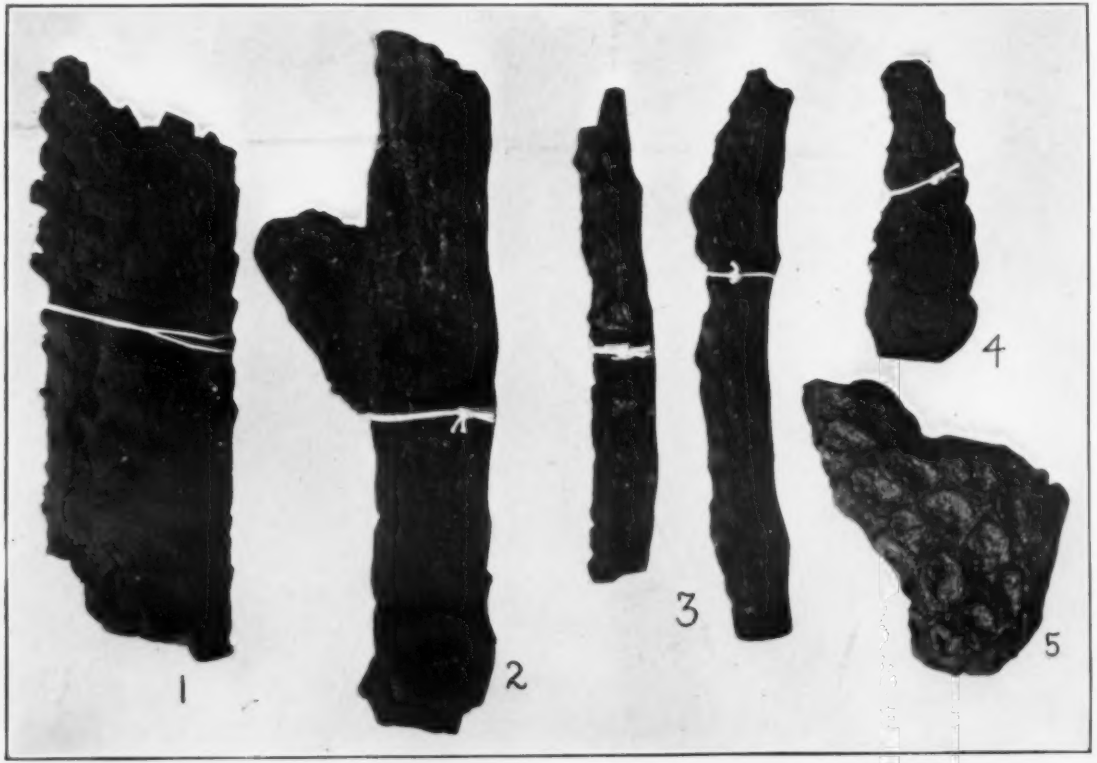

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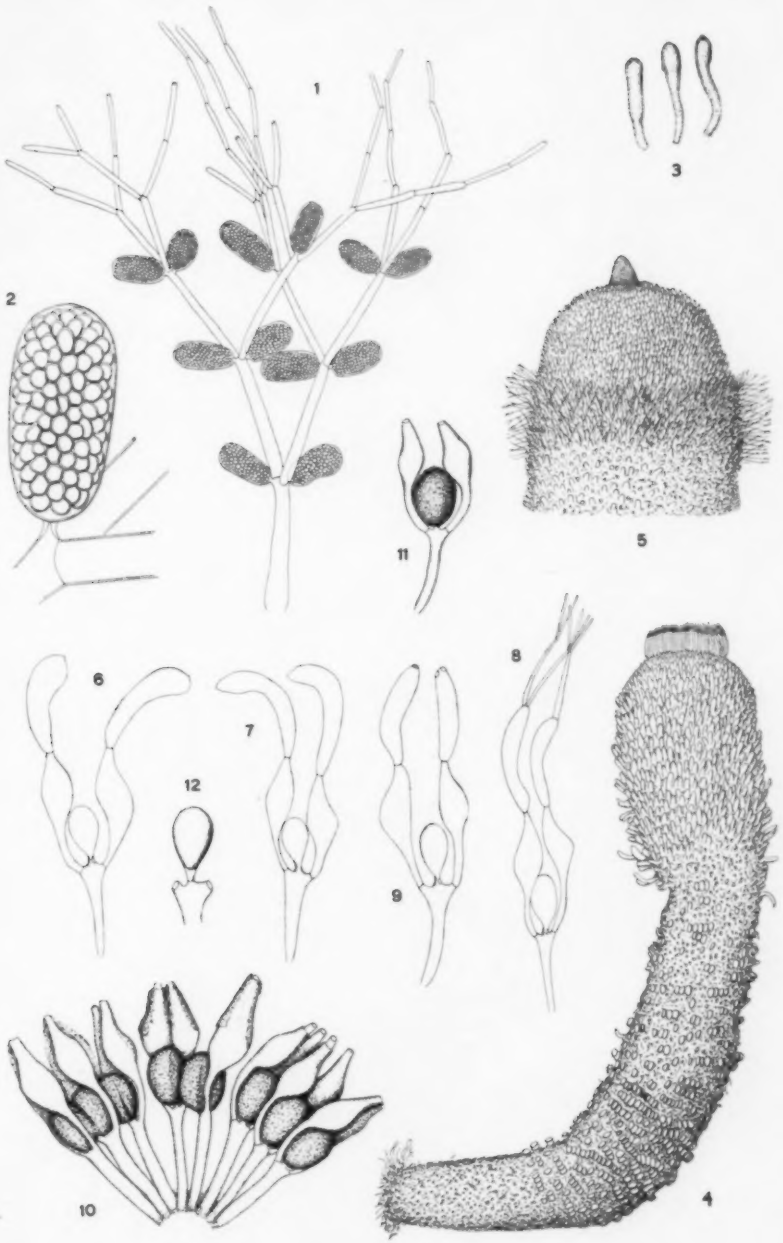

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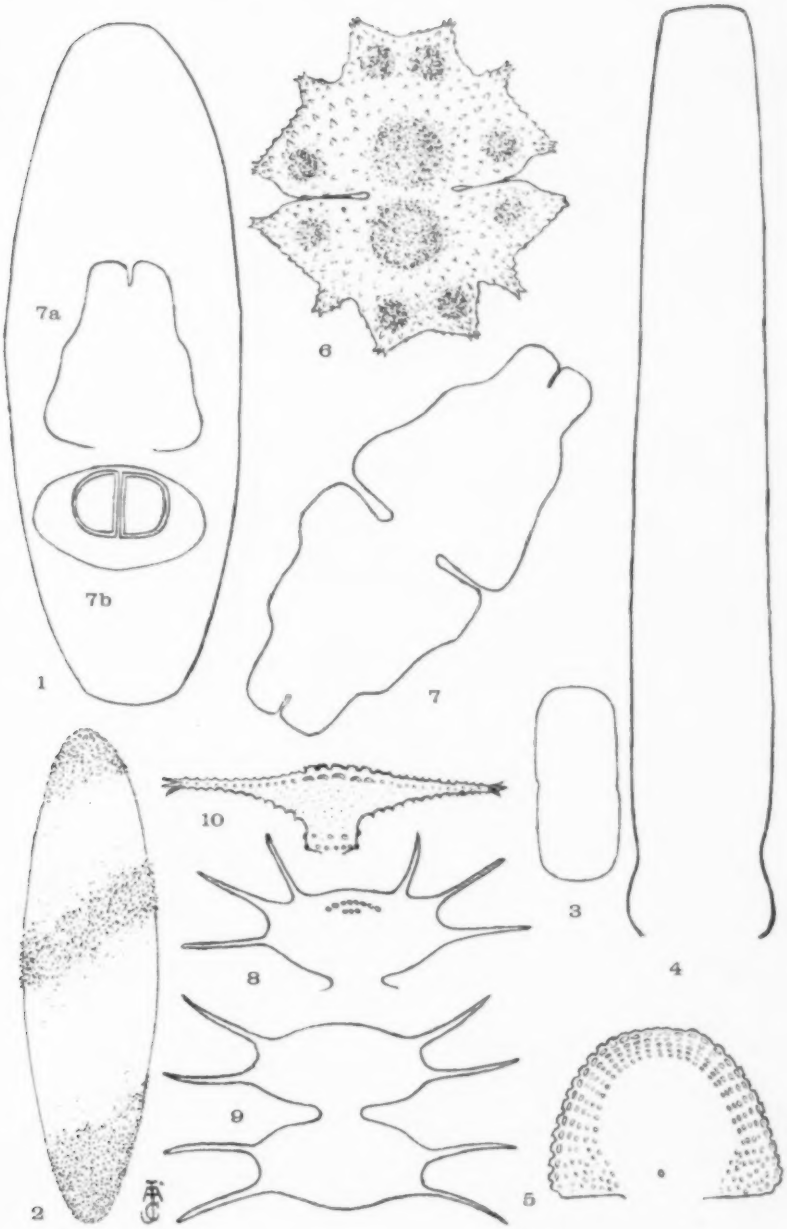

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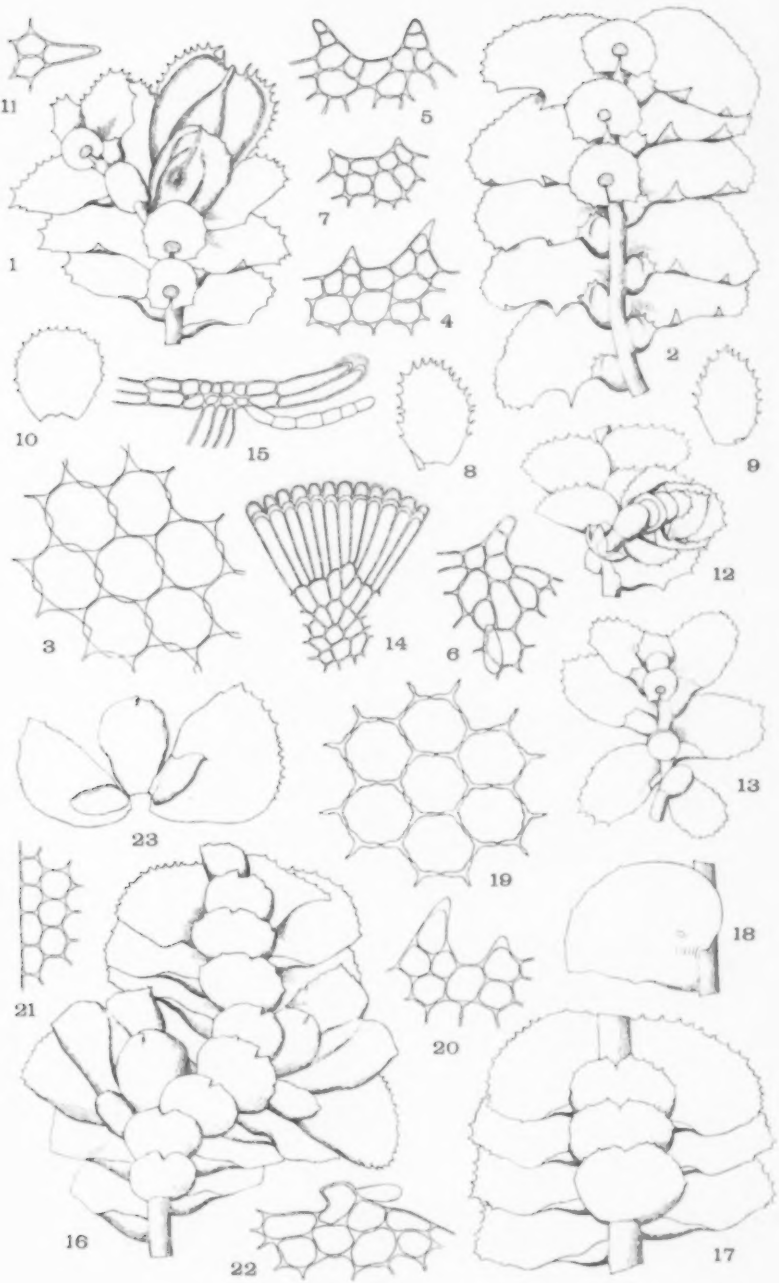

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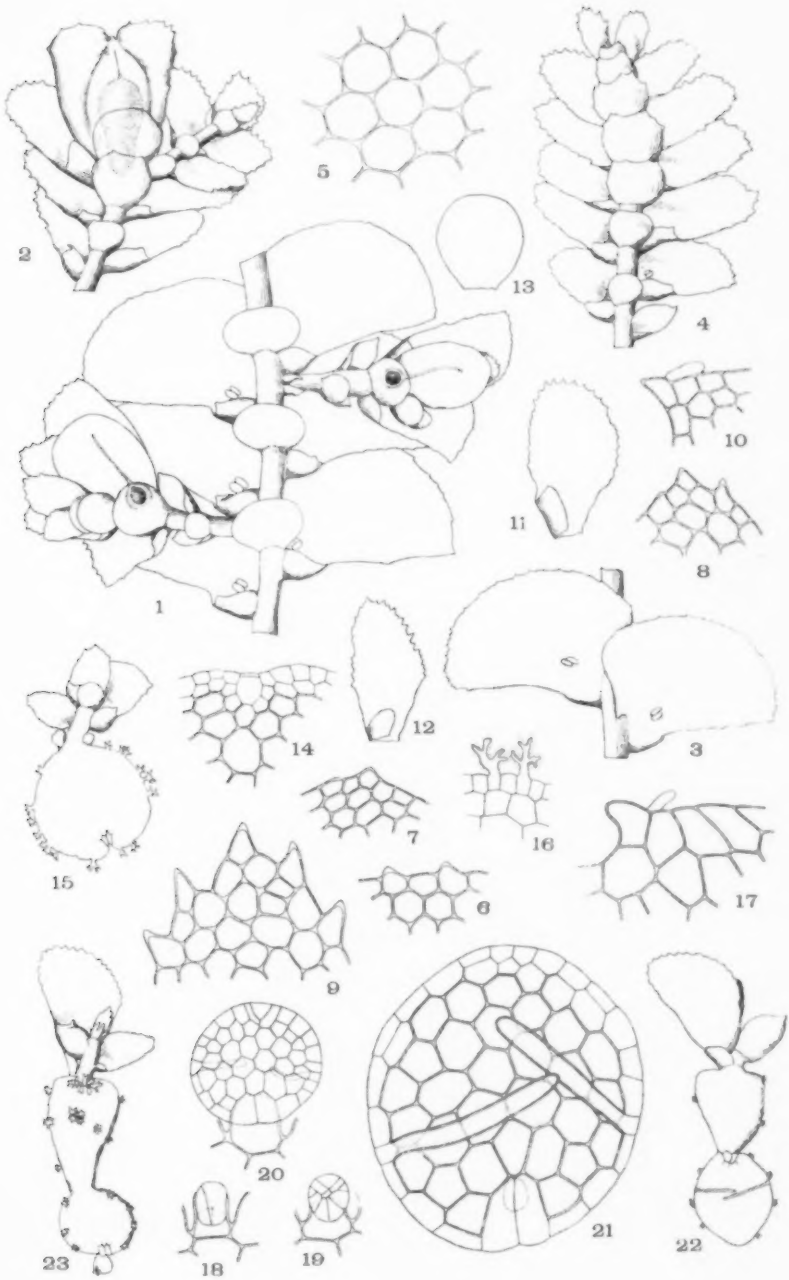

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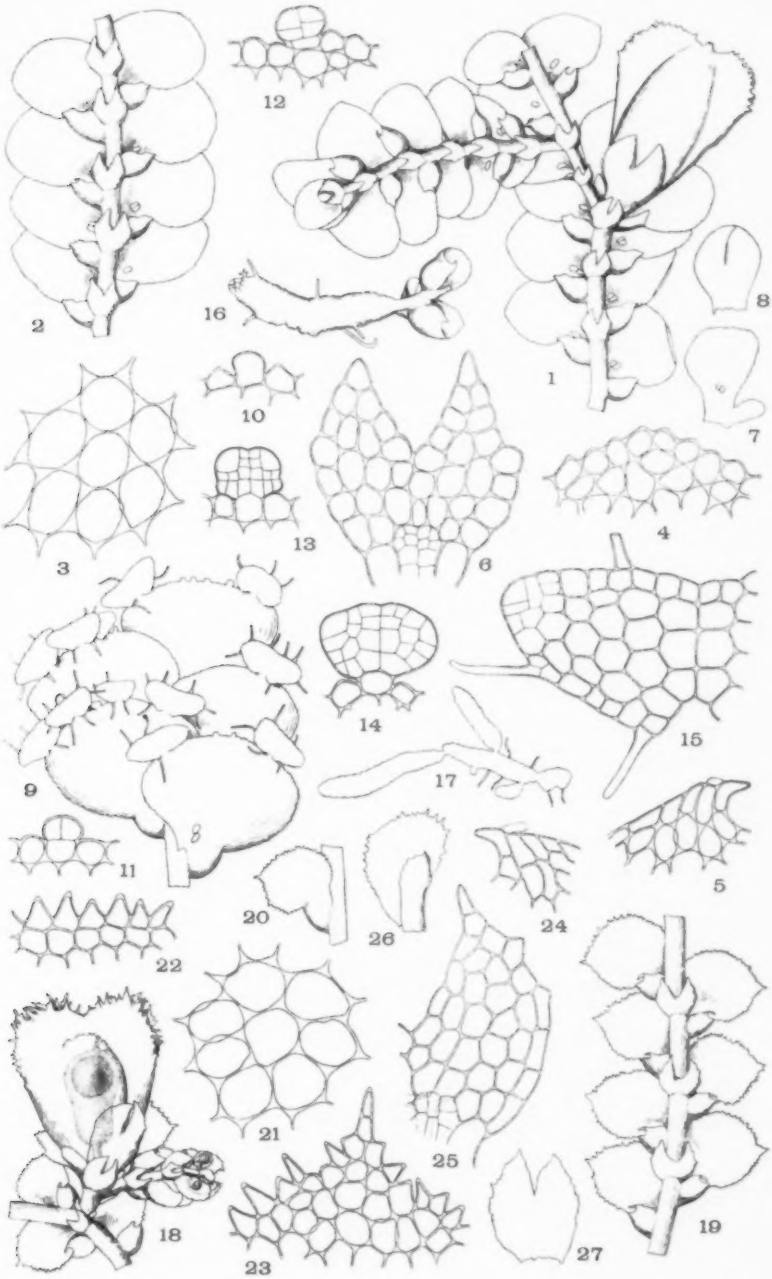

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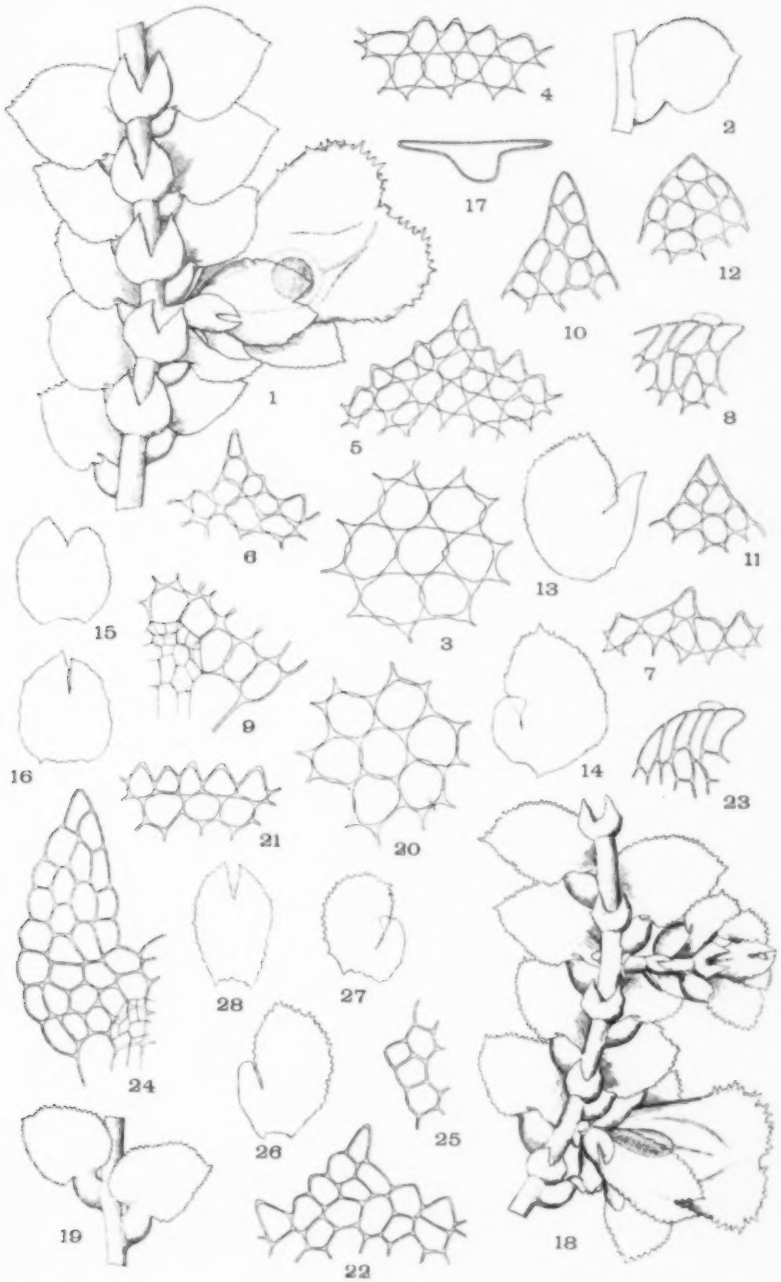

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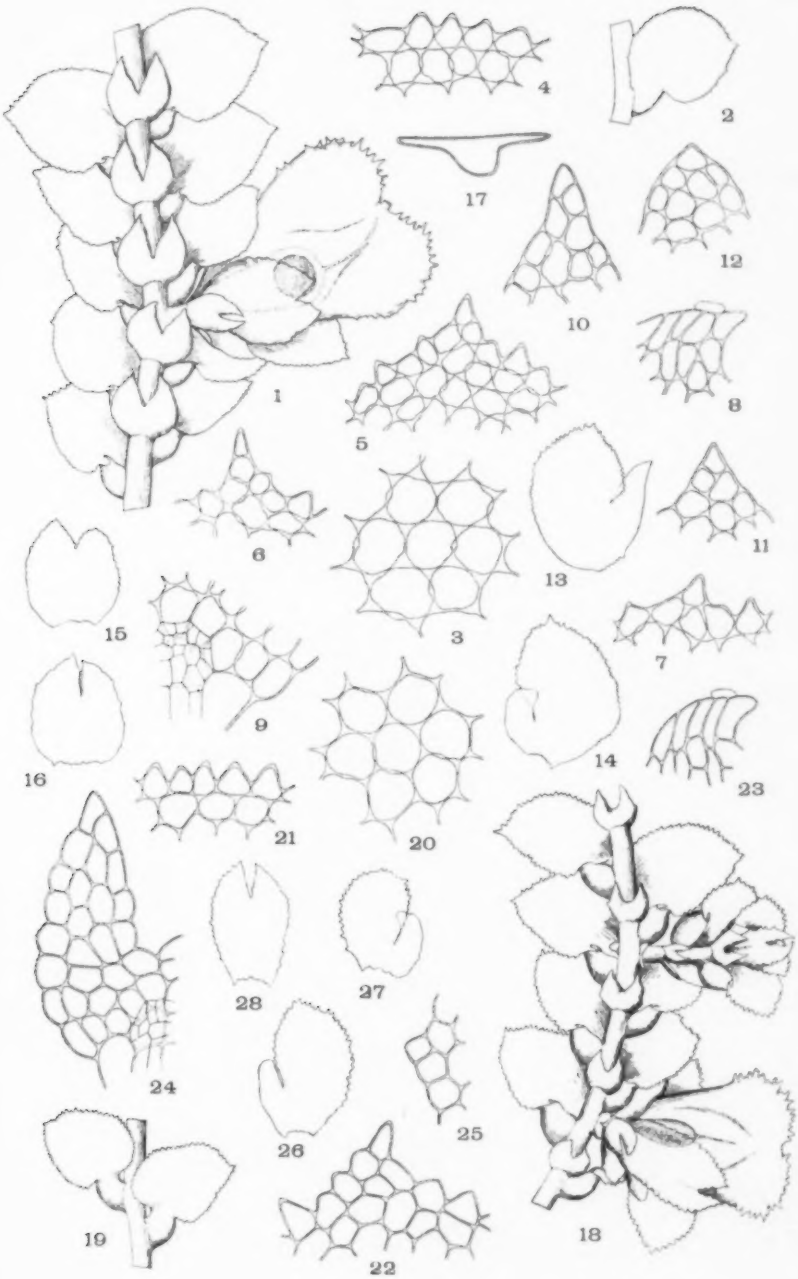

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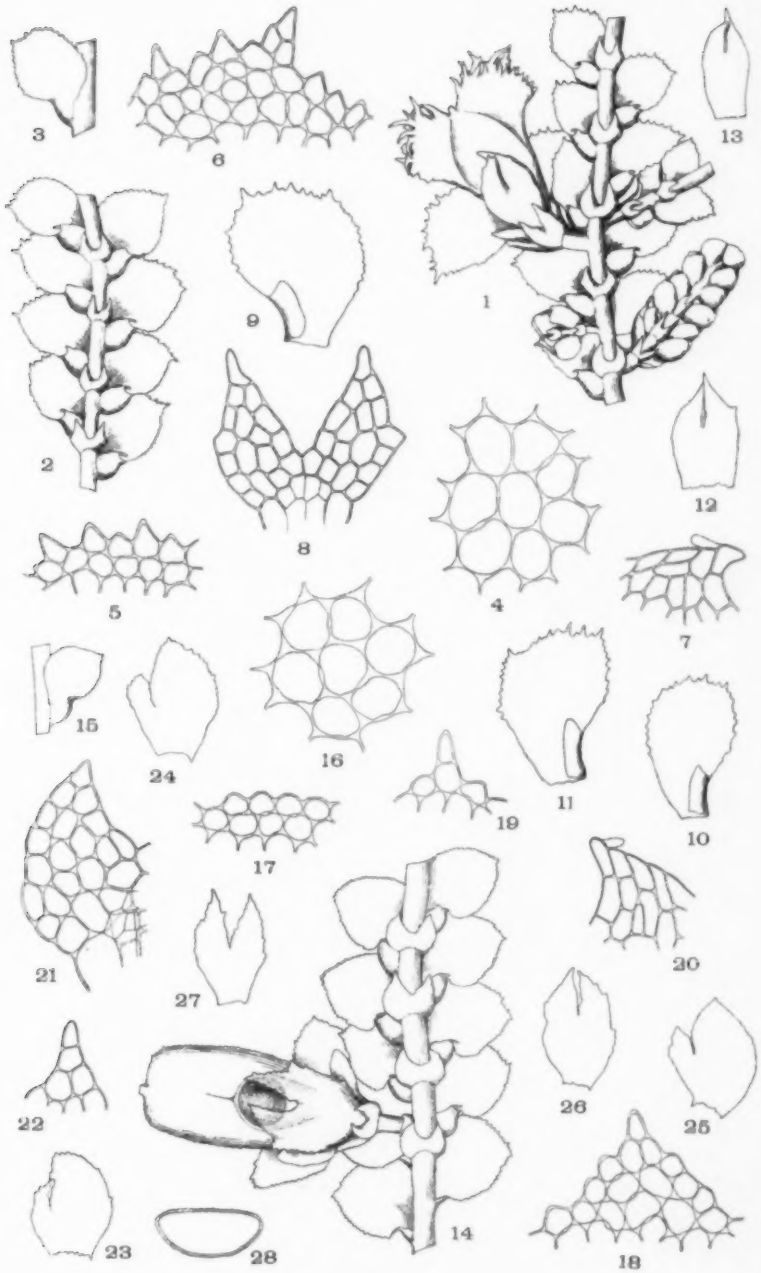

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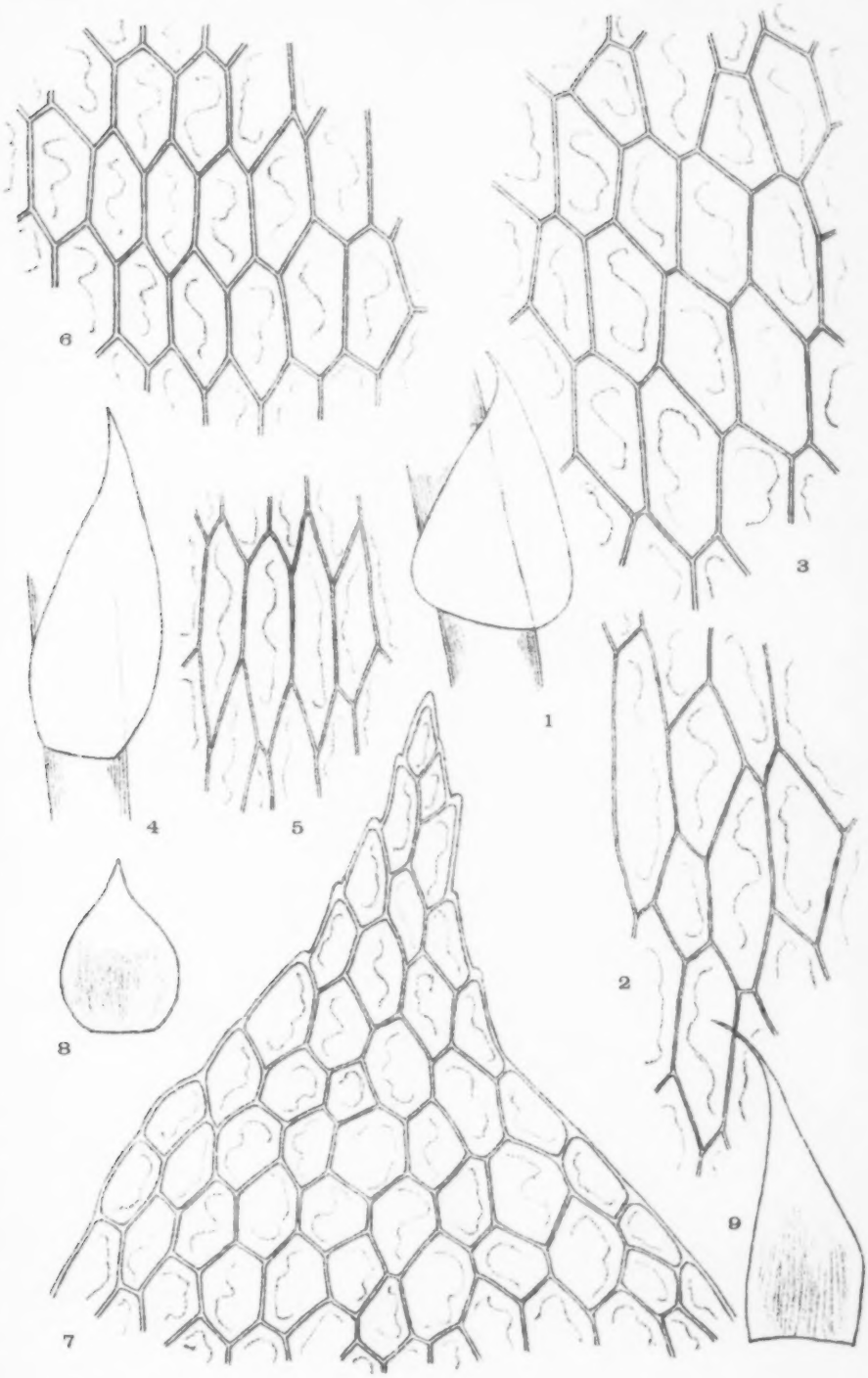

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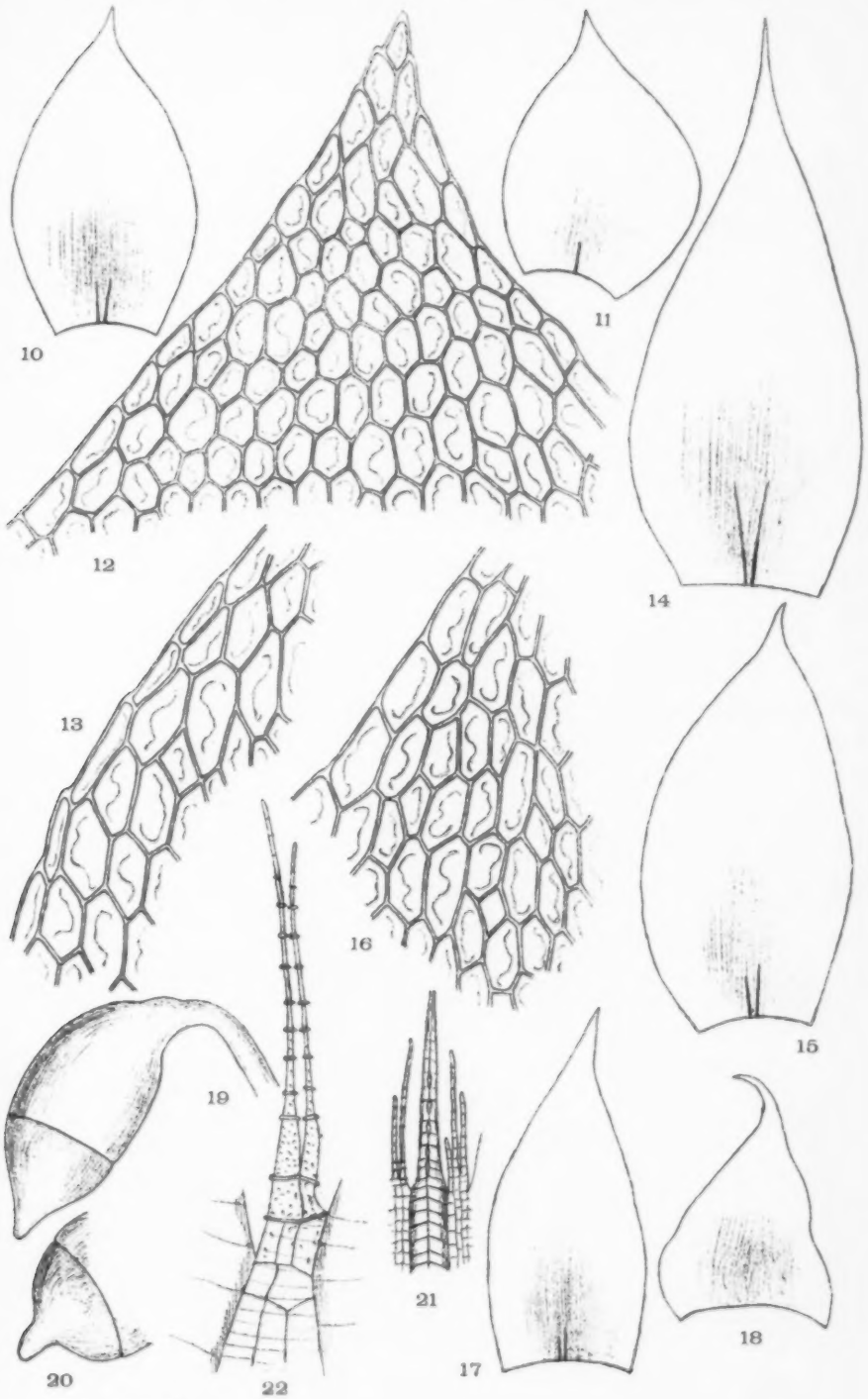

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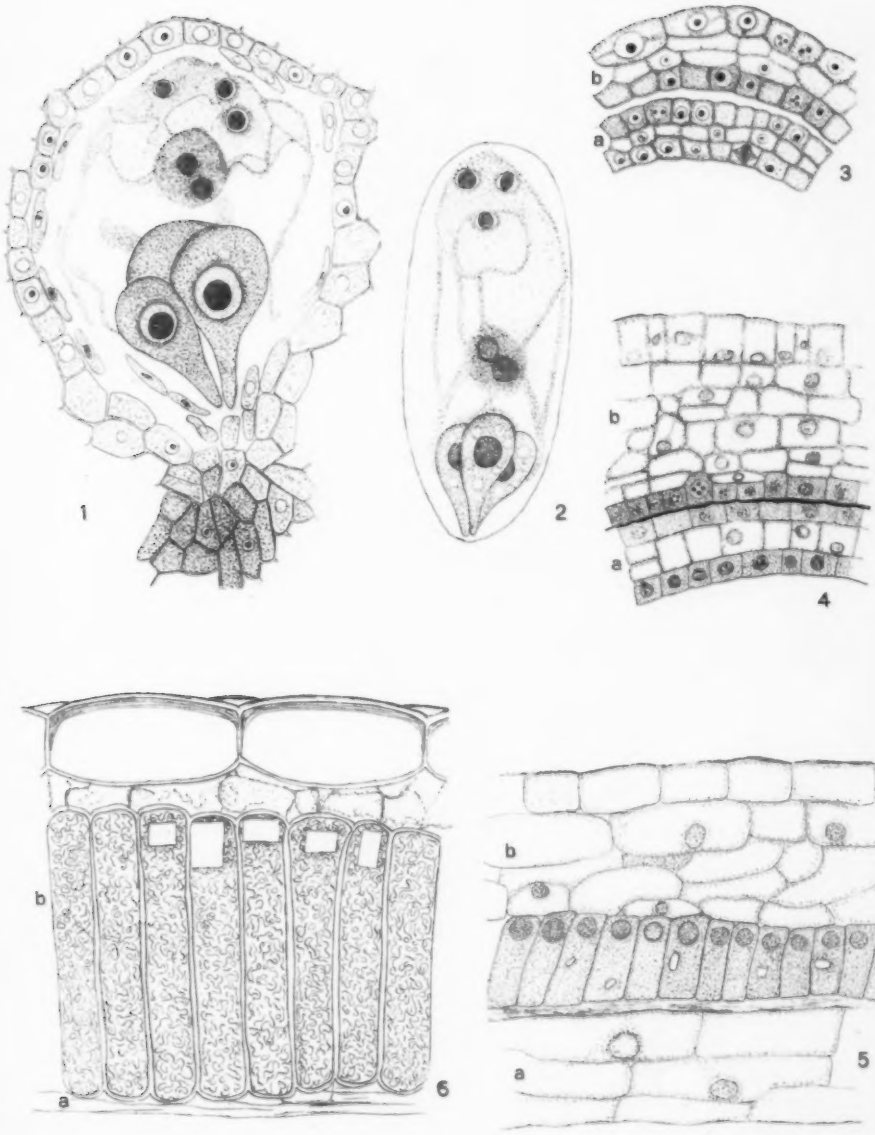

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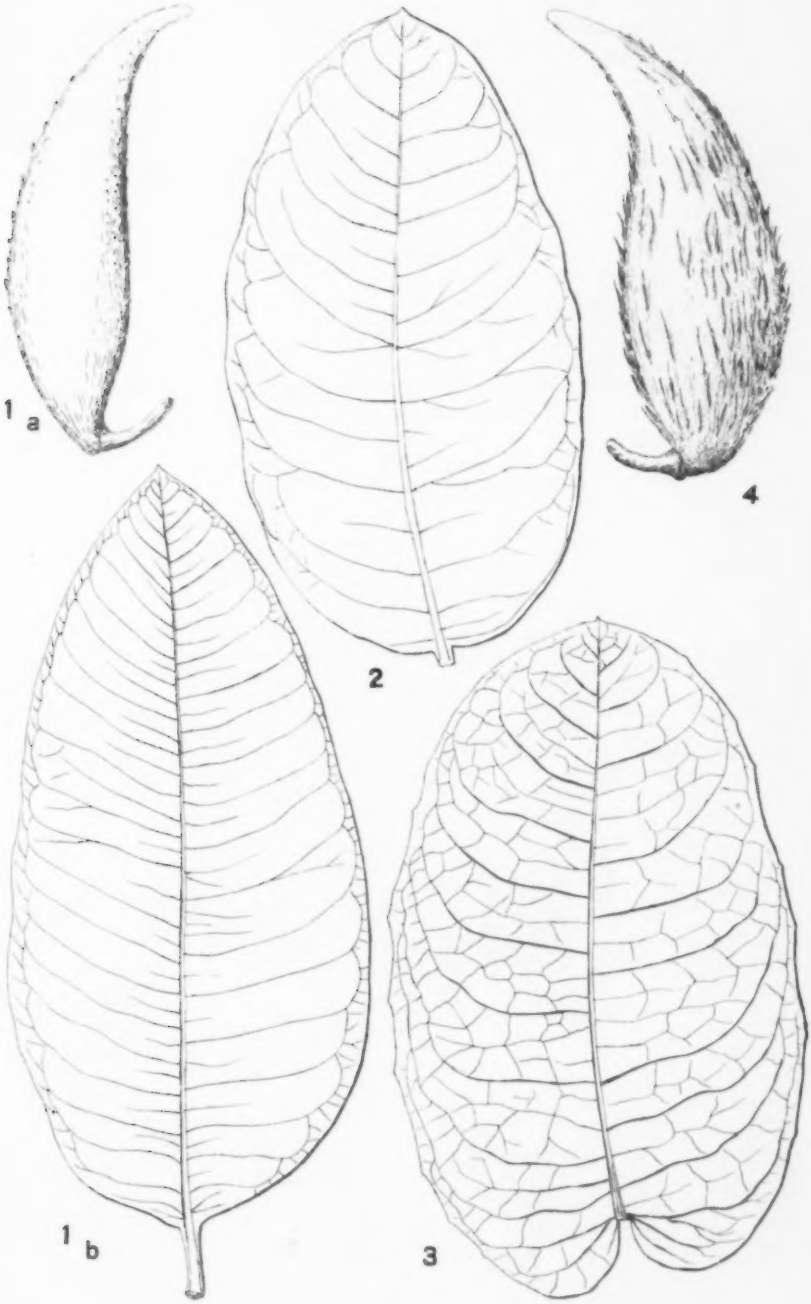

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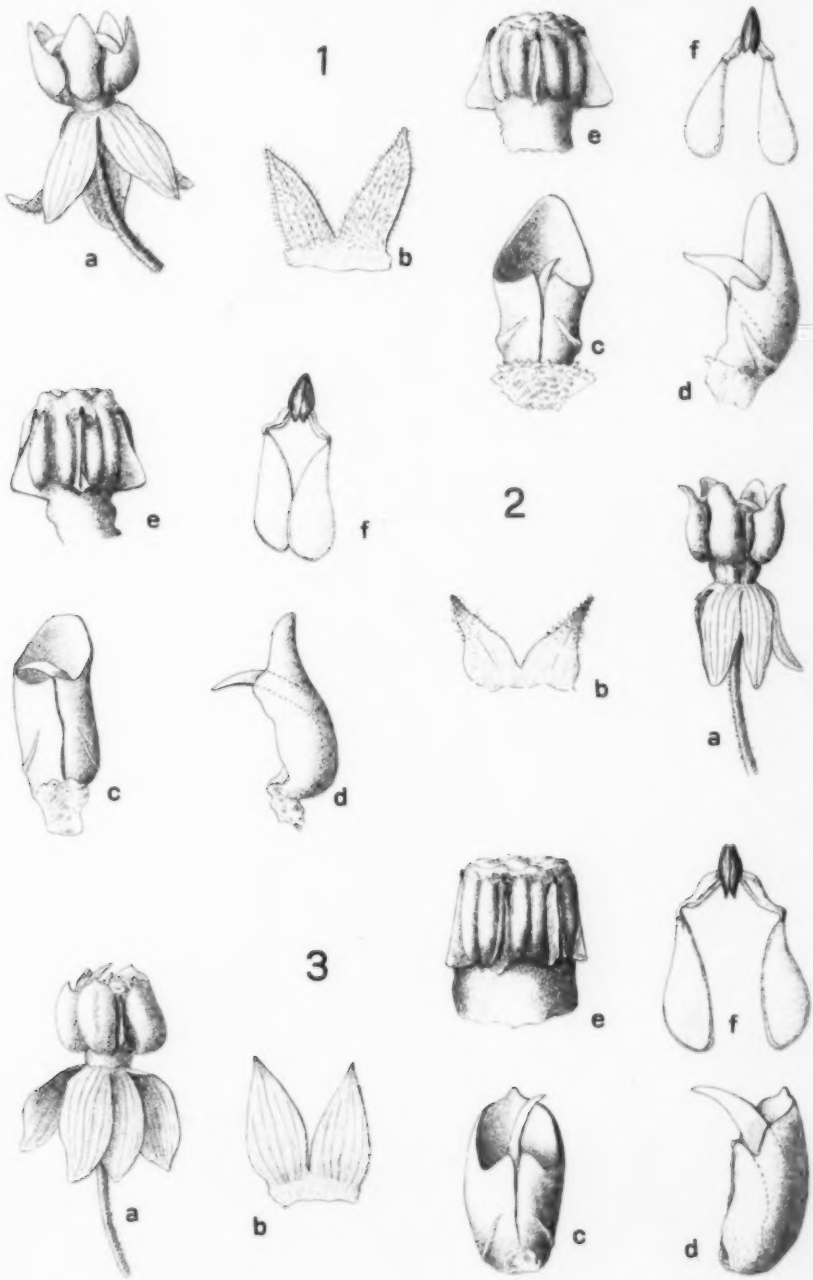

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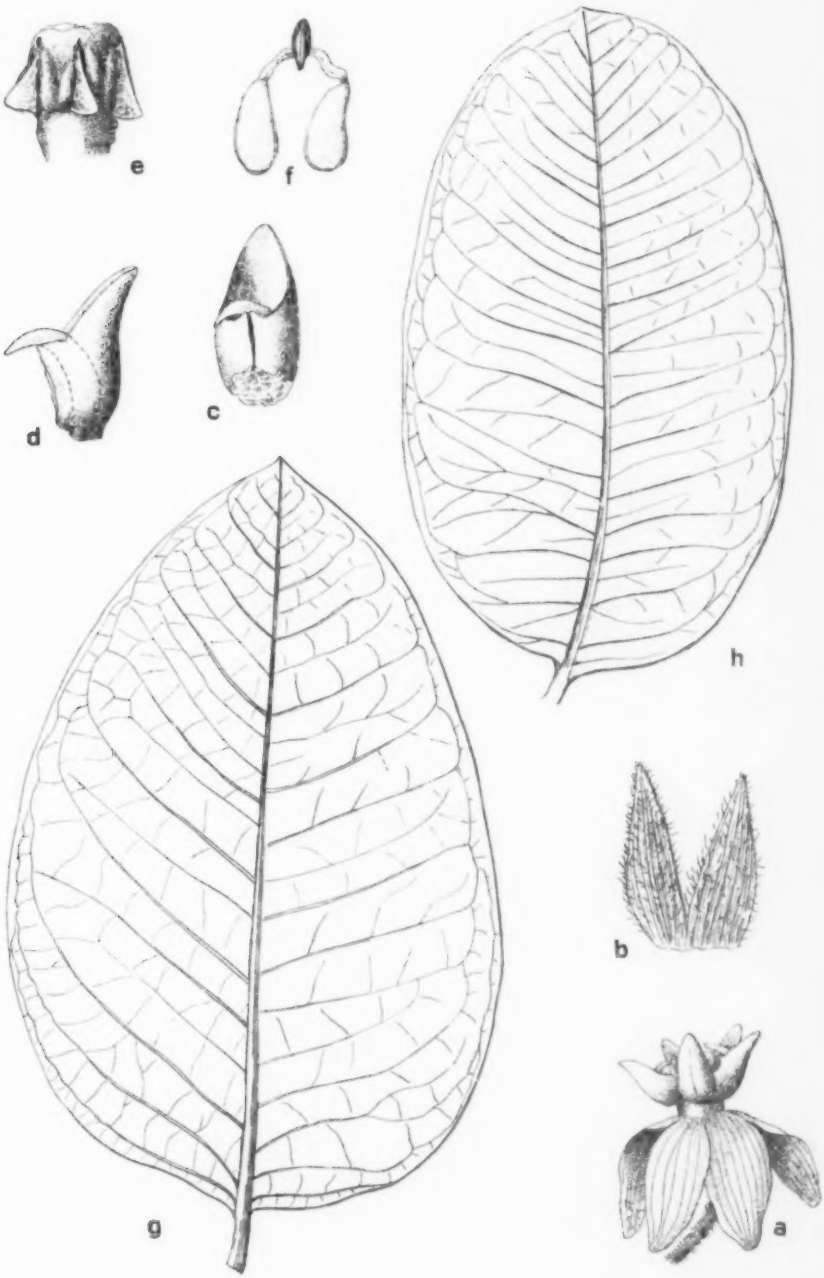

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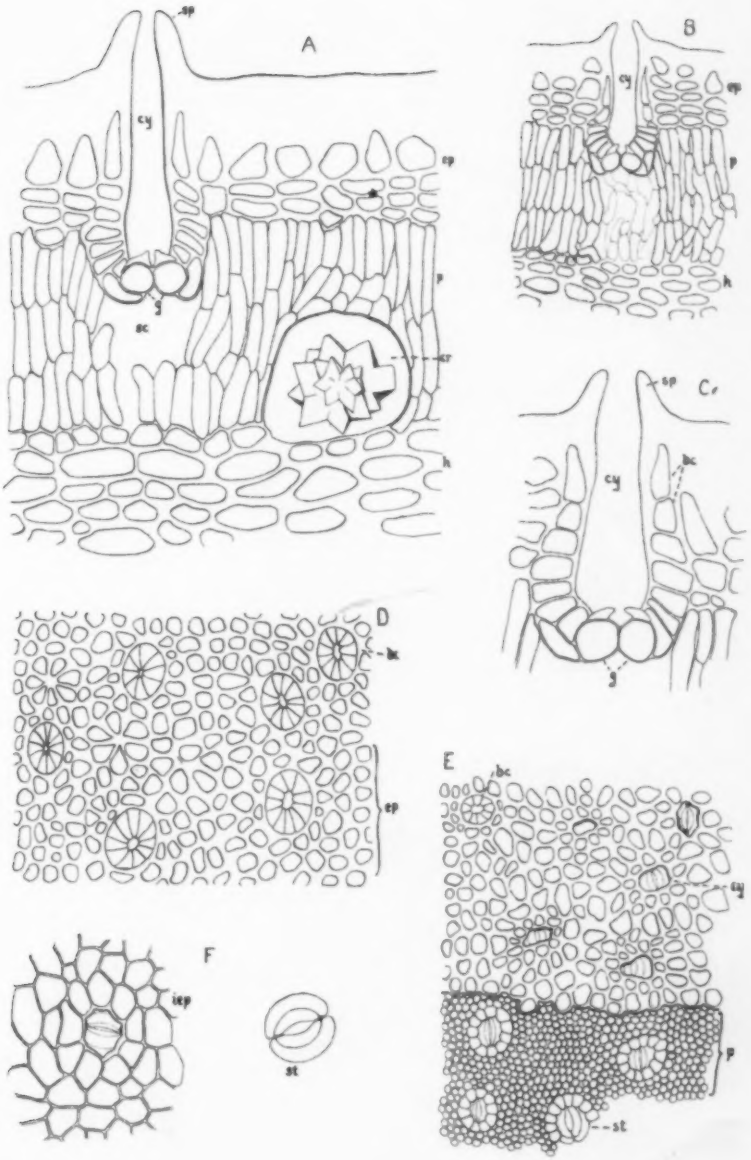

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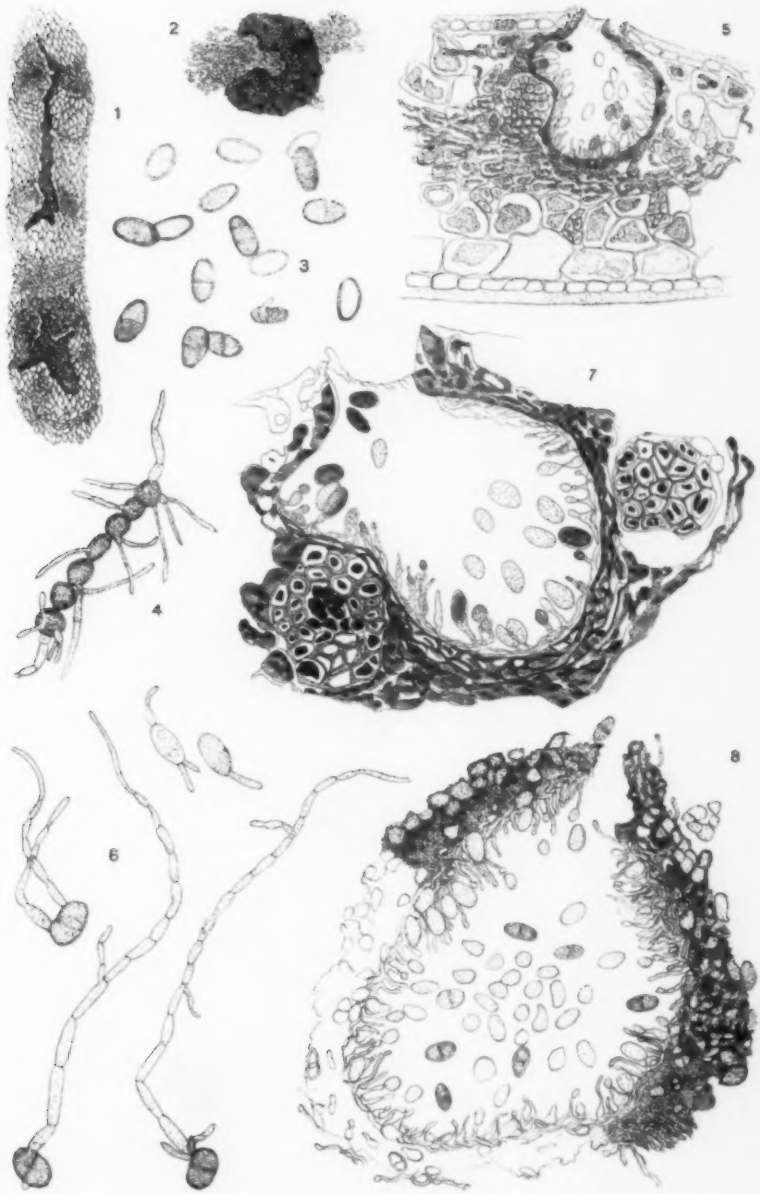

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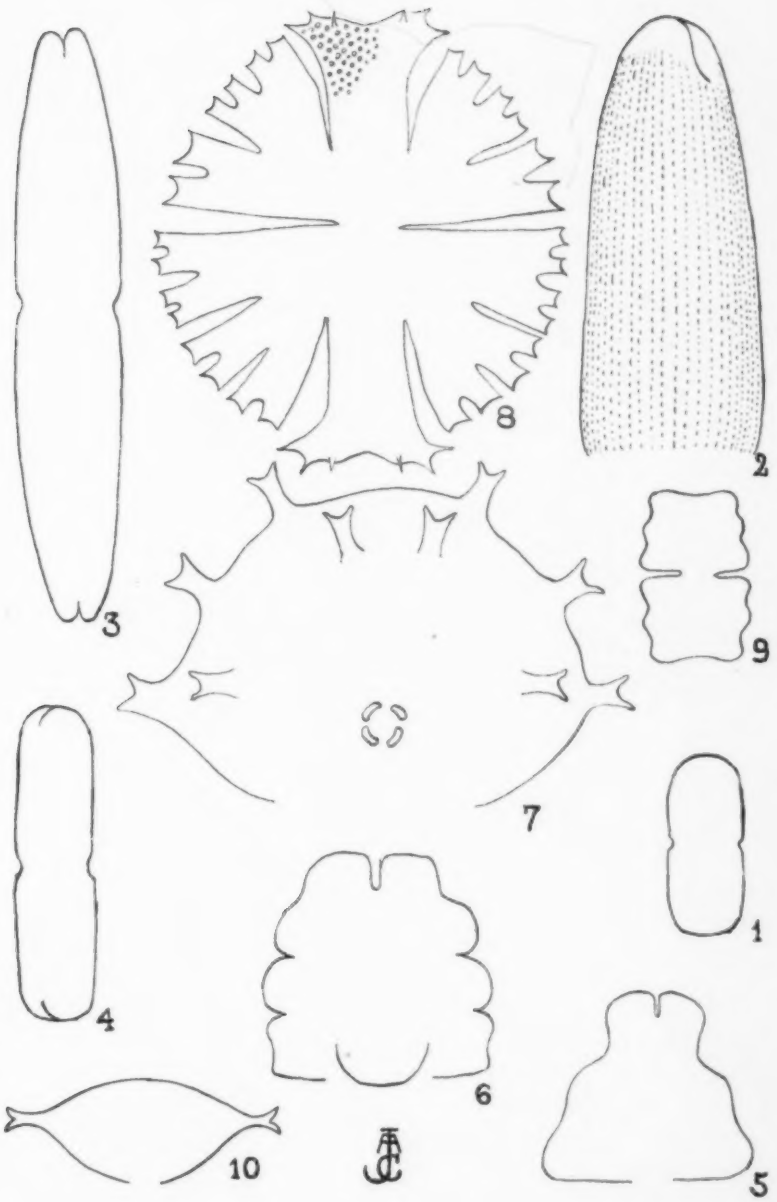

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